Table of Contents

Operators and Service Safety Summary xi

Specification

Product Description 1-1
General 1-1
User Interface 1-1
Menus 1-1
Indicators 1-2
General Purpose Knob 1-2
GUI 1-2
Signal Acquisition System 1-2
Horizontal System 1-3
Trigger System 1-3
Acquisition Control 1-4
On-Board User Assistance 1-4
Help 1-4
Autoset 1-4
Measurement Assistance 1-4
Cursor 1-5
Measure 1-5
Digital Signal Processing (DSP) 1-5
Storage and I/O 1-5
Display 1-6
Zoom 1-6
Nominal Traits 1-7
Warranted Characteristics 1-11
Performance Conditions 1-11
Typical Characteristics 1-17

Operating Information

Using this Manual 2-1
Before Servicing 2-1
Strategy for Servicing 2-1
Manual Structure 2-2

Manual Conventions 2-3
Modules 2-3
Safety 2-3
Symbols 2-3
Tektronix Service 2-4
Warranty Repair Service 2-4
Repair or Adjustment Service 2-4
Self Service 2-4
Finding Other Information 2-5
General Information 2-7
Supplying Operating Power 2-7
Power Cord Information 2-8
Operating Voltage 2-8
Memory Backup Power 2-8
Operating Environment 2-10
Operating Temperature 2-10
Ventilation Requirements 2-10
Applying and Interrupting Power 2-11
Power-Up 2-11
Power Down 2-11
Repackaging Instructions 2-12
Installed Options 2-12
General Operating Instructions 2-13
Screen Layout 2-13
Basic Procedures 2-13
How to Power Up 2-13

Theory of Operation

Circuit Description 3-1
Logic Conventions 3-1
Module Overview 3-1
General 3-1
Input Signal Path 3-1
Voltage Controlled Oscillator (VCO) 3-2
Firmface 3-2
Tube Assembly 3-2
Front Panel 3-3
Rear Panel 3-3
Low Voltage Power Supply 3-3
Fan 3-3

Performance Verification

Brief Procedures 4-1
General Instructions 4-1
Conventions 4-2
Self Tests 4-2
Verify Internal Adjustment, Self Compensation, and Diagnostics 4-4
Functional Tests 4-6
Verify All Input Channels 4-6
Verify the Time Base 4-8
Verify the Main and Delayed Trigger Systems 4-9
Performance Tests 4-11
Signal Acquisition System Checks 4-13
Check Accuracy of Offset (Zero Setting) 4-13
Check DC Gain and Voltage Measurement Accuracy 4-15
Check Analog Bandwidth 4-21
Check Delay Between Channels 4-25
Time Base System Checks 4-28
Check Accuracy for Long-Term Sample Rate, Delay Time, and Delta Time Measuments 4-28
Trigger System Checks 4-31
Check Accuracy (Time) for Pulse-Glitch or Pulse-Width Triggering 4-31
Check Accuracy, Trigger-level or Threshold, DC Coupled ... 4-34
Sensitivity, Edge Trigger, DC Coupled 4-37
Output Signal Checks 4-41
Check Probe Compensator Outputs 4-41

Adjustment Procedures

Adjustment Procedures 5-1
Requirements for Performance 5-1
Personnel 5-1
Warm-up Period 5-1
Access 5-1
System 5-2
Optional Peripherals 5-2
Test Equipment 5-2
Usage 5-2
Performing the Adjustments 5-2
Complete Adjustment 5-3
Individual Adjustments 5-3
Partial Adjustment 5-3
Adjustment After Repair 5-4
Adjustment Dependencies 5-4

Equipment Required **5-5**
Adjustment Instructions **5-6**
Hardware Installation 5-6
Software Installation 5-7
Adjustment Procedure 5-7
Probe Adjustment **5-9**
Compensate the Probe 5-9
Measure Probe Bandwidth 5-11
Adjust the Probe — High Frequency Response 5-14
Monitor Assembly Adjustment **5-17**
Brightness and Contrast Adjustment 5-17

Maintenance

Maintenance Information **6-1**
Procedures Not In This Section **6-1**
Preventing ESD **6-2**
Precautions 6-2
Susceptibility to ESD 6-2
Inspection and Cleaning **6-5**
General Care **6-5**
Inspection and Cleaning Procedures **6-5**
Inspect Exterior 6-6
Cleaning Procedure — Exterior 6-6
Inspect Interior 6-6
Cleaning Procedure — Interior 6-8
Lubrication 6-8
Removal and Installation Procedures **6-9**
Preparation — Please Read **6-9**
List of Modules 6-10
General Instructions 6-10
Summary of Procedures 6-10
Access Procedure **6-15**
Procedures for External Modules **6-16**
Front-Panel Knobs 6-16
Line Fuse and Line Cord 6-17
Rear Cover and Cabinet 6-19
A12 Front Cover, Trim Ring, Menu Buttons, and Attenuator Panel 6-21
A12 Front-panel Assembly and A13 Firmware Board 6-23
Cabinet Modules 6-26
Procedures for Outer-Chassis Modules **6-28**
A15 Attenuator Assembly 6-28
Display-Frame Assembly 6-29

Fan 6-30
A14 D1 Bus and Analog-Power and Digital-Power Cables .. 6-30
A11 Processor/Display Board 6-32
Top Cover and Board Brackets 6-34
A11/A12 Acquisition Board 6-35
Rear Chassis 6-36
Procedures for Inner-Chassis Modules 6-39
A17/A18/A19 Power Supply 6-39
A20 Display Assembly and Supply Fuse 6-39
Front Subpanel 6-43
Main Chassis 6-44
Disassembly for Cleaning 6-45
Troubleshooting 6-47
TDS 520 Diagnostics 6-47

Options

Options and Accessories 7-1
Options 7-1
Options A1–A5: International Power Cords 7-1
Option 1M: 50 ,000 Sample Record Length 7-1
Option 1R: Rackmounted TDS 520 Digitizing Oscilloscope . 7-1
Option 22: Additional Probes 7-2
Option 1P: HC100 4 Pen Plotter 7-2
Option 9C: Certificate of Calibration and Test Data Report .. 7-2
Standard Accessories 7-2
Probe Accessories 7-3
Optional Accessories 7-3
Accessory Probes 7-4
Probe Accessories 7-5
Accessory Software 7-6
Warranty 7-6

Replaceable Electrical Parts

Diagrams

Diagrams and Circuit Board Illustrations 9-1
Symbols 9-1
Component Values 9-1
Graphic Items and Special Symbols Used in This Manual ... 9-2
Component Locator Diagrams 9-3

Replaceable Parts

Replaceable Parts List 10-1
Parts Ordering Information 10-1
Using the Replaceable Parts List 10-2

Change Information

List of Figures

Figure 2-1: Map of Display Functions 2-14

Figure 4-1: Map of Display Functions 4-3
Figure 4-2: Verifying Adjustments and Signal-Path Compensation ... 4-5
Figure 4-3: Universal Test Hookup for Functional Tests 4-6
Figure 4-4: Measurement of DC Offset Accuracy at Zero Setting 4-15
Figure 4-5: Initial Test Hookup 4-16
Figure 4-6: Measurement of the DC Accuracy for Delta Measurements 4-17
Figure 4-7: Measurement of DC Accuracy at Maximum Offset and Position 4-20
Figure 4-8: Initial Test Hookup 4-21
Figure 4-9: Measurement of Analog Bandwidth 4-23
Figure 4-10: Initial Test Hookup 4-25
Figure 4-11: Measurement of Channel Delay 4-27
Figure 4-12: Initial Test Hookup 4-28
Figure 4-13: Measurement of Accuracy — Long-Term and Delay-Time 4-29
Figure 4-14: Initial Test Hookup 4-31
Figure 4-15: Measurement of Time Accuracy for Pulse and Glitch Triggering 4-33
Figure 4-16: Initial Test Hookup 4-34
Figure 4-17: Measurement of Trigger-Level Accuracy 4-36
Figure 4-18: Initial Test Hookup 4-37
Figure 4-19: Measurement of Trigger Sensitivity 4-39
Figure 4-20: Initial Test Hookup 4-41
Figure 4-21: Measurement of Probe Compensator Limits 4-42

Figure 5-1: Hookup for Probe Compensation 5-9
Figure 5-2: Performing Probe Compensation 5-10
Figure 5-3: Proper and Improper Probe Compensation 5-10
Figure 5-4: Exposing the Inner Probe Tip 5-11
Figure 5-5: Initial Test Hookup 5-12
Figure 5-6: Exposing the Probe Body 5-14
Figure 5-7: Initial Test Hookup 5-14
Figure 5-8: Locations of Probe Adjustments 5-16
Figure 5-9: Adjustments vs. Front-corner Response 5-16
Figure 5-10: Five and ten percent luminance patches 5-18

Figure 6-1: External Modules 6-12
Figure 6-2: Outer-Chassis Modules 6-13
Figure 6-3: Inner-Chassis Modules 6-14

Figure 6-4: Knob Removal 6-17
Figure 6-5: Line Fuse and Line Cord Removal 6-18
Figure 6-6: Rear Cover and Cabinet Removal 6-20
Figure 6-7: Front Cover, Trim Ring, Menu Buttons, and Attenuator Panel Removal (Front Cover not Shown) 6-22
Figure 6-8: A12 Front-Panel Assembly and A13 Firmface Board Removal 6-24
Figure 6-9: Disassembly of Front-Panel Assembly 6-25
Figure 6-10: Cabinet Modules Removal 6-27
Figure 6-11: Attenuator Interconnect Cable Routing and Jack Locations 6-29
Figure 6-12: A14 D1 Bus and Analog-Power and Digital-Power Cables Removal 6-31
Figure 6-13: Processor and Fan Removal 6-33
Figure 6-14: Board Bracket Removal 6-35
Figure 6-15: Acquisition Board Removal 6-36
Figure 6-16: Rear Chassis Removal 6-37
Figure 6-17: A/17/A18/A19 Supply Removal 6-39
Figure 6-18: Monitor Assembly Removal 6-41
Figure 6-19: High-Voltage Board Removal 6-42
Figure 6-20: Front Subpanel Removal 6-44
Figure 6-21: Primary Failure Troubleshooting Procedure 6-48
Figure 6-22: Module Isolation Troubleshooting Procedure 6-49
Figure 6-23: Low Voltage Power Supply Module Isolation 6-51
Figure 6-24: Monitor Troubleshooting Procedure 6-53
Figure 6-25: Horizontal and Vertical Sync Signals 6-54
Figure 6-26: Video Out Signal 6-54
Figure 6-27: Processor/Acquisition Troubleshooting Procedure 6-55
Figure 6-28: Processor/Front Panel Troubleshooting Procedure 6-56
Figure 6-29: Attenuator/AcquisitionTroubleshooting Procedure 6-57
Figure 6-30: A11 DRAM Processor/Display Module (View of right side) 6-58
Figure 6-31: A11 DRAM Processor/Display Module (View of lower left corner) 6-59
Figure 6-32: A10 Acquisition Module (View of lower left corner) 6-60

Figure 9-1: Graphic Items and Special Symbols Used in This Manual 9-2
Figure 9-2: Circuit Board Component Locator Diagram Key 9-3
Figure 9-3: TDS 540 Interconnections 9-4
Figure 9-4: TDS 540 Block Diagram 9-6

List of Tables

Table 1-1: Record Length vs Divisions per Record 1-3
Table 1-2: Nominal Trait – Signal Acquisition System 1-7
Table 1-3: Nominal Traits – Time Base System 1-8
Table 1-4: Nominal Traits – Triggering System 1-9
Table 1-5: Nominal Traits – Display System 1-9
Table 1-6: Nominal Traits – Interfaces, Output Ports, and Power Fuse 1-9
Table 1-7: Nominal Traits – Mechanical 1-10
Table 1-8: Warranted Characteristics – Signal Acquisition System .. 1-11
Table 1-9: Warranted Characteristics – Time Base System 1-13
Table 1-10: Warranted Characteristics – Triggering System 1-14
Table 1-11: Warranted Characteristics – Output Ports and Power Requirements 1-14
Table 1-12: Warranted Characteristics – Environmental, Safety, and Reliability 1-15
Table 1-13: Typical Characteristics – Signal Acquisition System ... 1-17
Table 1-14: Typical Characteristics – Time Base System 1-17
Table 1-15: Typical Characteristics – Triggering System 1-18
Table 1-16: Typical Characteristics – Data Handling and Reliability . 1-19

Table 2-1: Power-Cord Conductor Identification 2-8
Table 2-2: Power-Cord and Plug Identification 2-9
Table 2-3: Effects of Corrupted Data 2-11

Table 4-1: Test Equipment 4-12
Table 4-2: DC Offset Accuracy (Zero Setting) 4-14
Table 4-3: DC Accuracy: CH 1–CH 2 4-19
Table 4-4: DC Accuracy: AUX 1–AUX 2 4-19
Table 4-5: Analog Bandwidth 4-22

Table 5-1: Adjustments Required for Module Replaced 5-4
Table 5-2: Adjustments and Dependencies 5-4
Table 5-3: Test Equipment 5-5
Table 5-4: GPIB Board Configuration 5-6

Table 6-1: Relative Susceptibility to Static-Discharge Damage 6-3
Table 6-2: External Inspection Check List 6-6
Table 6-3: Internal Inspection Check List 6-7
Table 6-4: Tools Required for Module Removal 6-11
Table 6-5: Normal Supply Voltages (measured at the power supply connector) 6-52
Table 6-6: No-Load Supply Voltages 6-52

Table 7-1: International Power Cords 7-1
Table 7-2: Standard Accessories 7-2
Table 7-3: Probe Accessories 7-3
Table 7-4: Optional Accessories 7-3
Table 7-5: Probe Accessories 7-5
Table 7-6: Accessory Software 7-6

Operators and Service Safety Summary

Please take a moment to review these safety precautions. They are provided for your protection and to prevent damage to the digitizing oscilloscope. This safety information applies to all operators and service personnel.

Symbols and Terms

These two terms appear in manuals:

- CAUTION statements identify conditions or practices that could result in damage to the equipment or other property.
- WARNING statements identify conditions or practices that could result in personal injury or loss of life.

These two terms appear on equipment:

- *CAUTION* indicates a personal injury hazard not immediately accessible as one reads the marking, or a hazard to property including the equipment itself.
- *DANGER* indicates a personal injury hazard immediately accessible as one reads the marking.

This symbol appears in manuals:

Static-Sensitive Devices

These symbols appear on equipment:

DANGER
High Voltage

Protective
ground (earth)
terminal

ATTENTION
Refer to
manual

Specific Precautions

Observe all of the following precautions to ensure your personal safety and to prevent damage to either the TDS 520 or equipment connected to it.

Do Not Perform Service While Alone

Do not perform internal service or adjustment of this product unless another person capable of rendering first aid and resuscitation is present.

Use Care When Servicing With Power On

Dangerous voltages exist at several points in this product. To avoid personal injury, do not touch exposed connections or components while power is on. Disconnect power before removing protective panels, soldering, or replacing components.

Power Source

The TDS 520 is intended to operate from a power source that will not apply more than 250 V rms between the supply conductors or between either supply conductor and ground. A protective ground connection, through the grounding conductor in the power cord, is essential for safe system operation.

Grounding the digitizing oscilloscope

The TDS 520 is grounded through the power cord. To avoid electric shock, plug the power cord into a properly wired receptacle where earth ground has been verified by a qualified service person. Do this before making connections to the input or output terminals of the TDS 520.

Without the protective ground connection, all parts of the TDS 520 are potential shock hazards. This includes knobs and controls that may appear to be insulators.

Use the Proper Power Cord

Use only the power cord and connector specified for your product. Use only a power cord that is in good condition.

Use the Proper Fuse

To avoid fire hazard, use only the fuse specified in the parts list for your product, and which is identical in type, voltage rating, and current rating.

Do Not Remove Covers or Panels

To avoid personal injury, do not operate the TDS 520 without the panels or covers.

Do Not Operate in Explosive Atmospheres

The TDS 520 provides no explosion protection from static discharges or arcing components. Do not operate the TDS 520 in an atmosphere of explosive gasses.

Electric Overload

Never apply a voltage to a connector on the TDS 520 that is outside the range specified for that connector.

Product Description

This subsection begins with a general description of the traits of the TDS 520 Digitizing Oscilloscope. Three subsections follow, one for each of three classes of traits: *nominal traits, warranted characteristics,* and *typical characteristics*.

General

The Tektronix TDS 520 Digitizing Oscilloscope is a portable, four-channel instrument suitable for use in a variety of test and measurement applications and systems. It supplies two of full-featured channels, plus two auxiliary channels with three vertical scale factors: 100 mV, 1 V, and 10 V. Key features include:

- Two full-featured input channels, each with a record length of 15,000 samples and 8-bit vertical resolution. A 50,000 sample record length is available with the 1M option.
- Two auxiliary input channels, similar to the full-featured channels but with only three vertical scale settings: 100 mV, 1 V, and 10 V.
- A maximum digitizing rate of 500 MSamples/second with an analog bandwidth of 500 MHz.
- Extensive triggering capabilities: such as edge, logic, and glitch.
- Full programmability and printer/plotter output.
- Advanced functions like continuously-updated measurements.
- Specialized display modes, such as infinite and variable persistence.
- A unique graphical user interface (GUI), an on-board help mode, and a logical front-panel layout which combine to deliver a new standard in usability.

User Interface

This digitizing oscilloscope uses a combination of front-panel buttons, knobs, and on-screen menus to control its many functions. The front-panel controls are grouped according to function: vertical, horizontal, trigger, and special. Within each group, any function likely to get adjusted often, such as vertical positioning, or time base setting, is set directly by its own front-panel knob.

Menus

Those functions for which control settings are usually changed less often, such as vertical coupling and horizontal mode, are set indirectly. That is, pressing one (sometimes two) front-panel button, such as vertical menu, displays a menu of functions at the bottom of the screen that are related to

that button. (For the button vertical menu, the menu displayed contains the functions such as coupling, bandwidth, etc.) Using the buttons below this *main* menu to select a function, such as coupling, displays a *side* menu of settings for that function, such as AC, DC, or GND (ground) coupling at the right side of the screen. Use the buttons to the right of the menu to select a setting, such as DC.

Indicators

Several on-screen readouts help you keep track of the settings for various functions, such as vertical and horizontal scale and trigger level. There are also readouts to display the results of measurements made using cursors or using the automatic parameter extraction feature (called measure) and readouts to display the status of the instrument.

General Purpose Knob

Menus can also be used to assign the general purpose knob to adjust a selected parameter function. The method employed is the same as for *selecting* a function, except the final selection in the side menu causes the general purpose knob to *adjust* some function, such as the position of measurement cursors on screen, or the setting for a channel's fine gain.

GUI

The user interface also makes use of a GUI, or Graphical User Interface, to make setting functions and interpreting the display more intuitive. Some menus and status are displayed using iconic representations of function settings such as those shown here for full, 100 MHz, and 20 MHz bandwidth. Such icons allow you to more readily determine status or the available settings.

Signal Acquisition System

The signal acquisition system of the TDS 520 provides four vertical channels: two full-featured vertical channels (CH 1 and CH 2) with calibrated vertical scale factors from 1 mV to 10 V per division, plus two auxiliary channels (AUX 1 and AUX 2) with three calibrated vertical scale factors of 100 mV, 1 V, and 10 V per division. Any two of the four channels can be acquired simultaneously.

Each of the four channels can be displayed, vertically positioned, and offset; CH 1 and CH 2 can also have their bandwidth limited (100 MHz or 20 MHz) and their vertical coupling specified. Fine gain can also be adjusted for CH 1 and CH 2.

Besides the four channels, up to three math waveforms and four reference waveforms are available for display. (A math waveform results when you specify dual waveform operations, such as add, on any two channels; a reference waveform results when you save a live waveform in a reference memory.)

Horizontal System

There are three horizontal display modes: main only, main intensified, and delayed only. You can select among various horizontal record length settings (see Table 1-1).

Table 1-1: Record Length vs Divisions per Record

Record Length	Divisions per Record (50 Samples/Division)
50000	1000 divs[1]
15000	300 divs
5000	100 divs
2500	50 divs
1000	20 divs
500	10 divs

[1]**The 50,000 samples in 1,000 division record is only available with Option 1M.**

Both the delayed only display and the intensified zone on the main intensified display may be delayed by time with respect to the main trigger. Both can be set to display immediately after the delay (delayed runs after mainmode); the delayed display can also be set to display at the first valid trigger after the delay (delayed triggerable mode).

The delayed display (or the intensified zone) may also be delayed by a selected number of events. In such a case, the events source can be the delayed trigger source, or an events signal input into CH 1 or CH 2. For any events signal, the delayed-trigger system conditions the signal by determining the source, coupling, etc., of that signal.

Trigger System

The triggering system comprises a rich set of features for triggering the signal-acquisition system. Types of trigger signals recognized include:

- **Edge** (main- and delayed-trigger systems): This familiar type of triggering is fully configurable for source, slope, coupling, mode (auto or normal), and holdoff.
- **Logic** (main-trigger system): This type of triggering can be based on pattern (asynchronous) or state (synchronous). In either case, logic triggering is configurable for sources, for boolean operators to apply to those sources, for logic pattern or state on which to trigger, for mode (auto or normal), and for holdoff.
- **Pulse** (main-trigger system): Pulse triggering is configurable for triggering on runt or glitch pulses, or on pulse widths, frequency, or period inside or outside limits that you specify. It is also configurable for source, polarity, mode, and holdoff.

You can choose where the trigger point is located within the acquired waveform record by selecting the amount of pretrigger data displayed. Presets of 10%, 50%, and 90% of pretrigger data can be selected in the horizontal menu, or the General Purpose knob can be assigned to set pretrigger data to any value within the limits of trigger position resolution.

Acquisition Control

Depending on your measurement requirements, you can specify the mode and manner in which signals are acquired and processed:

- You can select Equivalent-time sampling on repetitive signals or interpolation of points sampled on non-repetitive signals. Both can increase apparent sample rate on the waveform when maximum real-time rates are reached.
- Peak-detect, high-resolution, sample, envelope, and average modes can be used to acquire signals.
- The acquisition can be set to stop after a single trigger, acquisition, or sequence of acquisitions or after a certain portion of limit tests or test conditions are met.

On-Board User Assistance

Two features that help you set up this digitizing oscilloscope to make your measurements are help and autoset.

Help

Help displays operational information about any front-panel control. When help mode is in effect, manipulating any front-panel control causes the digitizing oscilloscope to display information about that control. When help is first invoked, an introduction to help is displayed on screen.

Autoset

Autoset automatically sets up the digitizing oscilloscope for a viewable display based on the input signal.

Measurement Assistance

Once you have set up to make your measurements, the features cursor and measure can help you quickly make those measurements.

Cursor

Two types of cursors are provided for making parametric measurements on the displayed waveforms. Voltage can be measured between the positions of H Bar (horizontal) cursors and time can be measured between V Bar (vertical) cursors. These are delta measurements; that is, measurements based on the difference between two cursors.

Both V Bar and H Bar cursors can also be used to make absolute measurements—measurements relative to a defined level or event. In the case of the H Bars, either cursor can be selected to read out its voltage with respect to any channel's ground reference level; in the case of the V Bars, its time with respect to the trigger point (event) of the acquisition.

For delta-time measurements, units can be either seconds or Hz (for 1/time).

Measure

Measure can automatically extract parameters from the signal input to the digitizing oscilloscope. Any four out of the more than 20 parameters available can be displayed to the screen. The displayed parameters are extracted continuously and the results updated on-screen as the digitizing oscilloscope continues to acquire waveforms.

Digital Signal Processing (DSP)

An important component of the multiprocessor architecture of this digitizing oscilloscope is Tektronix's proprietary digital signal processor, the DSP. This dedicated processor supports advanced analysis of your waveforms when doing such compute-intensive tasks as interpolation, waveform math, and signal averaging. It also teams with measure to provide local pass/fail testing of waveforms and with a custom display system to deliver specialized display modes (See *Display*, later in this description.)

Storage and I/O

Acquired waveforms may be saved in any of four nonvolatile REF (reference) memories. Any or all of the saved waveforms may be displayed for comparison with the waveforms being currently acquired.

The source and destination of waveforms to be saved may be chosen. Assignment can be made to save any of the four channels to any REF memory or to move a stored reference from one REF memory to another. Reference waveforms may also be written into a REF memory location via the GPIB interface.

The digitizing oscilloscope is fully controllable and capable of sending and receiving waveforms over the GPIB interface (IEEE 488.1-1987/IEEE 488.2-1987 standard). This feature makes the instrument ideal for making automated measurements in a production or research and development environment that calls for repetitive data taking. Self-compensation and self-diagnostic features built into the digitizing oscilloscope to aid in fault detection and servicing are also accessible using commands sent from a GPIB controller.

Another standard feature is hardcopy. This feature allows you to output waveforms and other on-screen information to a variety of graphic printers and plotters from the digitizing oscilloscope front panel, providing hardcopies without requiring you to put the digitizing oscilloscope into a system-controller environment. The hardcopies obtained are WYSIWYG (What-You-See-Is-What-You-Get), based on what is displayed at the time hardcopy is invoked.

Display

The TDS 520 Digitizing Oscilloscope offers flexible display options. You can customize the following attributes of your display:

- Intensity: waveforms, readouts, graticule, etc.
- Style of waveform display(s): vectors or dots, intensified or non-intensified samples, and infinite or variable persistence
- Display format: xy or yt and graticule type

Zoom

This digitizing oscilloscope also provides an easy way to focus in on those waveform features you wish to examine up close. By invoking zoom, you can magnify the waveform parameter using the vertical and horizontal controls to expand (or contract) and position it for viewing.

Nominal Traits

This subsection contains a collection of tables that list the various *nominal traits* that describe the TDS 520 Digitizing Oscilloscope. Included are electrical and mechanical traits.

Nominal traits are described using simple statements of fact such as "Two, both identical" for the trait "Input Channels, Number of," rather than in terms of limits that are performance requirements.

Table 1-2: Nominal Trait — Signal Acquisition System

Name	Description	
Bandwidth Selections	20 MHz, 100 MHz, and FULL (500 MHz)	
Digitizers, Number of	Two, both identical	
Digitized Bits, Number of	8 bits[1]	
Input Channels, Number of	Two full-featured (CH 1 and CH 2), plus two limited, auxiliary inputs (AUX 1 and AUX 2)[2]	
Input Coupling	DC, AC, or GND	
Input Impedance Selections	1 MΩ or 50 Ω	
Ranges, Offset, CH 1 and CH 2	**Volts/Div Setting**	**Offset Range**
	1 mV/div–99.5 mV/div	±1 V
	100 mV/div–995 mV/div	±10 V
	1 V/div–10 V/div	±100 V
Ranges, Offset, AUX 1 and AUX 2	**Volts/Div Setting**	**Offset Range**
	100 mV/div	±0.5 V
	1 V/div	±5.0 V
	10 V/div	±50 V

[1]Displayed vertically with 25 digitization levels (DLs) per division and 10.24 divisions dynamic range with zoom off. A DL is the smallest voltage level change that can be resolved by the 8-bit A-D Converter, with the input scaled to the volts/division setting of the channel used. Expressed as a voltage, a DL is equal to 1/25 of a division times the volts/division setting.

[2]The input characteristics *(Input Coupling, Input Impedance Selections, etc.)* apply to both full-featured and auxiliary inputs except where otherwise specified.

Table 1-2: Nominal Trait — Signal Acquisition System (Cont.)

Name	Description	
Range, Position	±5 divisions	
Range, Sensitivity, CH 1 and CH 2	1 mV/div to 10 V/div[3]	
Range, Sensitivity, AUX 1 and AUX 2	100 mV/div, 1 V/div, and 10 V/div[4]	
Rise Time[5]	**Volts/Div Setting**	**Rise Time**
	5 mV/div–10 V/div	700 ps
	2 mV/div–4.98 mV/div	1 ns
	1 mV/div–1.99 mV/div	1.2 ns

[3]The sensitivity ranges from 1 mV/div to 10 V/div in a 1–2–5 sequence of coarse settings. Between a pair of adjacent coarse settings, the sensitivity can be finely adjusted. The resolution of such a fine adjustment is 1% of the more sensitive of the pair. For example, between 50 mV/div and 100 mV/div, the volts/division can be set with 0.5 mV resolution.

[4]There is no fine adjustment between the three sensitivity selections for AUX 1 and AUX 2.

[5]Rise time is defined by the following formula: $\text{Rise Time (ns)} = \frac{350}{\text{BW (MHz)}}$

Table 1-3: Nominal Traits — Time Base System

Name	Description	
Range, Sample-Rate[1,3]	**Number of Channels On**	**Sample-Rate Range**
	1	Samples/s–500 MSamples/s
	2	Samples/s–250 MSamples/s
Range, Equivalent Time or Interpolated Waveform Rate[2,3]	500 MSamples/s to 100 GSamples/s (2 ns/Sample to 1 ps/Sample)	
Range, Seconds/Division	500 ps/div to 10 s/div	
Range, Time Base Delay Time	4 ns to 250 seconds	
Record Length Selection	500 samples, 1000 samples, 2500 samples, 5000 samples, 15000 samples. A record length 50000 samples is available with Option 1M.	

[1]The range of real-time rates, expressed in samples/second, at which a digitizer samples signals at its inputs and stores the samples in memory to produce a record of time-sequential samples

[2]The range of waveform rates for equivalent time or interpolated waveform records.

[3]The Waveform Rate (WR) is the equivalent sample rate of a waveform record. For a waveform record acquired by real-time sampling of a single acquisition, the waveform rate is the same as the real-time sample rate; for a waveform created by interpolation of real-time samples from a single acquisition or by equivalent-time sampling of multiple acquisitions, the waveform rate is faster than the real time sample rate. For all three cases, the waveform rate is 1/(Waveform Interval) for the waveform record, where the waveform interval (WI) is the time between the samples in the waveform record.

Table 1-4: Nominal Traits — Triggering System

Name	Description	
Range, Delayed Trigger Time Delay	4 ns to 250 seconds	
Range, Events Delay	2 to 9,999,999	
Range (Time) for Pulse-Glitch or Pulse-Width Triggering	2 ns to 1 s	
Ranges, Trigger Level or Threshold	**Source**	**Range**
	Any Channel	±12 divisions from center of screen
	Line	±300 V

Table 1-5: Nominal Traits — Display System

Name	Description
Video Display Resolution	640 pixels horizontally by 480 pixels vertically in a display area of 5.2 inches horizontally by 3.9 inches vertically
Waveform Display Graticule	Single Graticule: 401 × 501 pixels/8 × 10 divisions, where divisions are 1 cm by 1 cm
Waveform Display Grey Scale	Sixteen levels in infinite-persistence and variable persistence display styles

Table 1-6: Nominal Traits — Interfaces, Output Ports, and Power Fuse

Name	Description
Interface, GPIB	GPIB interface complies with IEEE 488.1-1987 and 488.2-1987
Logic Polarity for Main- and Delayed-Trigger Outputs	Negative TRUE. High to low transition indicates the trigger occurred.
Fuse Rating	Either of two fuses[1] may be used: a .25″ × 1.25″ (UL 198.6, 3AG): 6 A FAST, 250 V, or a 5 mm × 20 mm, (IEC 127): 5 A (T), 250 V.

[1]**Each fuse type requires its own fuse cap.**

Table 1-7: Nominal Traits — Mechanical

Name	Description
Cooling Method	Forced-air circulation with no air filter
Construction Material	Chassis parts constructed of aluminum alloy; front panel constructed of plastic laminate; circuit boards constructed of glass-laminate. Cabinet is aluminum and is clad in Tektronix Blue vinyl material.
Finish Type	Tektronix Blue vinyl-clad aluminum cabinet
Weight	Standard digitizing oscilloscope 12.3 kg (27 lbs), with front cover. 20.0 kg (44 lbs), when packaged for domestic shipment. Rackmount digitizing oscilloscope 12.3 kg (27 lbs) plus weight of rackmount parts, for the rackmounted digitizing oscilloscope (Option 1R). 20.5 kg (45 lbs), when the rackmounted digitizing oscilloscope is packaged for domestic shipment. Rackmount conversion kit 2.3 kg (5 lbs), parts only; 3.6 kg (8 lbs), parts plus package for domestic shipping.
Overall Dimensions	Standard digitizing oscilloscope Height: 236 mm (9.3 in), when feet and accessories pouch are installed. 193 mm (7.6 in), without the accessories pouch installed. Width: 445 mm (17.5 in), with handle. Depth: 432 mm (17.0 in), with front cover installed. Rackmount digitizing oscilloscope Height: 178 mm (7.0 in). Width: 483 mm (19.0 in). Depth: 558.8 mm (22.0 in).

Warranted Characteristics

This subsection lists the various *warranted characteristics* that describe the TDS 520 Digitizing Oscilloscope. Included are electrical and environmental characteristics.

Warranted characteristics are described in terms of quantifiable performance limits which are warranted.

NOTE

In these tables, those warranted characteristics that are checked in the procedure Performance Verification, *found in Section 4, appear in* ***boldface type*** *under the column* **Name**.

As stated above, this subsection lists only warranted characteristics. A list of *typical characteristics* starts on page 1-17.

Performance Conditions

The electrical characteristics found in these tables of warranted characteristics apply when the scope has been adjusted at an ambient temperature between +20°C and +30°C, has had a warm-up period of at least 20 minutes, and is operating at an ambient temperature between 0°C and +50°C (unless otherwise noted).

Table 1-8: Warranted Characteristics — Signal Acquisition System

Name	Description	
Accuracy, DC Gain	±1%.	
Accuracy, DC Voltage Measurement, Averaged	**Measurement Type**	**DC Accuracy**
	Average of ≥16 waveforms	±(1.0% × (reading − Net Offset[1]) + Offset Accuracy + 0.06 div)
	Delta volts between any two averages of ≥16 waveforms[2]	±(1.0% × reading + 0.1 div + 0.3 mV)

[1]**Net Offset = Offset − (Position x Volts/Div). Net Offset is the voltage level at the center of the A-D converter's dynamic range. Offset Accuracy is the accuracy of this Voltage level.**

[2]**The samples must be acquired under the same setup and ambient conditions.**

Table 1-8: Warranted Characteristics — Signal Acquisition System (Cont.)

Name	Description	
Accuracy, Offset (CH 1 and CH 2)	**Volts/Div Setting**	**Offset Accuracy**
	1 mV/div – 99.5 mV/div	± (0.2% of Net Offset[1] + 1.5 mV + 0.1 div)
	100 mV/div – 995 mV/div	± (0.2% of Net Offset[1] + 15 mV + 0.1 div)
	1 V/div – 10 V/div	± (0.2% of Net Offset[1] + 150 mV + 0.1 div)
Accuracy, Offset (AUX 1 and AUX 2)	± (1% of Net Offset[1] + 0.1 div)	
Analog Bandwidth, DC-50 Ω Coupled	**Volts/Div**	**Bandwidth[3]**
	5 mV/div – 10 V/div	DC – 500 MHz
	2 mV/div – 4.98 mV/div	DC – 350 MHz
	1 mV/div – 1.99 mV/div	DC – 250 MHz
Cross Talk (Channel Isolation)	≥100:1 at 100 MHz and ≥30:1 at 500 MHz for any two channels having equal volts/division settings	
Delay Between Channels, Full Bandwidth, Equivalent Time	≤250 ps for any two channels with equal volts/division and coupling settings	
Input Impedance, DC-1 MΩ Coupled	1 MΩ ±0.5% in parallel with 10 pF ±2 pF.	
Input Impedance, DC-50 Ω Coupled	50 Ω ±1% with VSWR ≤1.3:1 from DC – 500 MHz	
Input Voltage, Maximum, DC-1 MΩ, AC-1 MΩ, or GND Coupled	±400 V (DC + peak AC); derate at 20 dB/decade above 1 MHz	
Input Voltage, Maximum, DC-50 Ω or AC-50 Ω Coupled	5 V rms, with peaks less than or equal to ±30 V	
Lower Frequency Limit, AC Coupled	≤10 Hz when AC-1 MΩ Coupled; ≤200 kHz when AC-50 Ω coupled[4]	

[1]Net Offset = Offset – (Position x Volts/Div). Net Offset is the voltage level at the center of the A-D converter's dynamic range. Offset Accuracy is the accuracy of this voltage level.

[3]The limits given are for the ambient temperature range of 0°C to +30°C. Reduce the upper bandwidth frequencies by 2.5 MHz for each °C above +30°C.

[4]The AC Coupled Lower Frequency Limits are reduced by a factor of 10 when 10X, passive probes are used.

Table 1-9: Warranted Characteristics — Time Base System

Name	Description
Accuracy, Long Term Sample Rate and Delay Time	±25 ppm over any ≥1 ms interval
Accuracy, Delta Time Measurement	For single-shot acquisitions using sample or high-resolution acquisition modes and aquired in CH 1 or CH 2:

Channels On/Bandwidth Selected	Measurement Accuracy[1,2]
1 channel/100 MHz	± (1 WI + 25 ppm of Reading + 500 ps)
2 channels/20 MHz	± (1 WI + 25 ppm of Reading + 1.3 ns)

For repetitive acquisitions using average acquisition mode with ≥8 averages:

Channels On/Bandwidth Selected	Measurement Accuracy[1,2]
1 to 2 Channels/Full Bandwidth	± (1 WI + 25 ppm of Reading + 200 ps)

[1]For input signals ≥ 5 divisions in amplitude and a slew rate of ≥ 2.0 divisions/ns at the delta time measurement points. Signal must have been acquired at a volts/division setting ≥ 5 mV/division.

[2]The WI (waveform interval) is the time between the samples in the waveform record. Also, see the footnotes for *Sample Rate Range* and *Equivalent Time or Interpolated Waveform Rates* in Table 1-3 on page 1-8.

Table 1-10: Warranted Characteristics — Triggering System

Name	Description		
Accuracy (Time) for Pulse-Glitch or Pulse-Width Triggering	**Time Range**	**Accuracy**	
	2 ns to 1 μs	±(20% of setting + 1.5 ns)	
	1.02 μs to 1 s	±(1000 ns + .0025% of setting)	
Accuracy, Trigger Level or Threshold, DC Coupled	±(2% of (Setting - Net Offset[1]) + 0.2 div × Volts/Div setting + Offset Accuracy)		
Sensitivity, Edge-Type Trigger, DC Coupled[2]	0.35 division from DC to 50 MHz, increasing to 1 division at 500 MHz		
Width, Minimum Pulse and Rearm, for Pulse Triggering	**Pulse Class**	**Minimum Pulse Width**	**Minimum Rearm Width**
	Glitch	2 ns	5 ns + 5% of Glitch Width Setting
	Runt	2.5 ns	2.5 ns
	Width	2 ns	5 ns + 5% of Width Upper Limit Setting

[1]Net Offset = Offset - (Position x Volts/Div). Net Offset is the voltage level at the center of the A-D converter's dynamic range. Offset Accuracy is the accuracy of this voltage level.

[2]The minimum sensitivity for obtaining a stable trigger. A stable trigger results in a uniform, regular display triggered on the selected slope. The trigger point must not switch between opposite slopes on the waveform, and the display must not "roll" across the screen on successive acquisitions. The TRIG'D LED stays constantly lighted when the SEC/DIV setting is 2 ms or faster but may flash when the SEC/DIV setting is 10 ms or slower.

Table 1-11: Warranted Characteristics — Probe Compensator Output Ports and Power Requirements

Name	Description	
Output Voltage and Frequency, Probe Compensator	**Characteristic**	**Limits**
	Voltage	0.5 V (base-top) ±5% into a 1 MΩ load; 0.25 V (base-top) ±7.5% into a 50 Ω load
	Frequency	1 kHz ±5%
Source Voltage	90 to 250 VAC rms, continuous range	
Source Frequency	47 Hz to 63 Hz	
Power Consumption	≤300 W (450 VA)	

Table 1-12: Warranted Characteristics — Environmental, Safety, and Reliability

Name	Description
Atmospherics	Temperature: 0°C to +50°C, operating; −40°C to +75°C, non-operating Relative humidity: 0 to 95%, at or below +40°C; 0 to 75%, +41°C to 50°C Altitude: To 15,000 ft. (4570 m), operating; to 40,000 ft. (12190 m), non-operating
Dynamics	Random vibration: 0.31 g rms, from 5 to 500 Hz, 10 minutes each axis, operating; 2.46 g rms, from 5 to 500 Hz, 10 minutes each axis, non-operating
Emissions	Meets or exceeds the requirements of the following standards: MIL-STD-461C CE-03, part 4, curve #1, RE-02, part 7 VDE 0871, Category B FCC Rules and Regulations, Part 15, Subpart J, Class A
User-Misuse Simulation	Electrostatic Discharge Susceptibility: Up to 8 kV with no change to settings or impairment of normal operation; up to 15 kV with no damage that prevents recovery of normal operation

Typical Characteristics

This subsections contains tables that lists the various *typical characteristics* that describe the TDS 520 Digitizing Oscilloscope.

Typical characteristics are described in terms of typical or average performance. Typical characteristics are not warranted.

This subsection lists only typical characteristics. A list of warranted characteristics starts on page 1-11.

Table 1-13: Typical Characteristics – Signal Acquisition System

Name	Description				
Accuracy, DC Voltage Measurement, Not Averaged	**Measurement Type**	**DC Accuracy**			
	Any Sample	±(1.0% × (reading – Net Offset[1]) + Offset Accuracy + 0.13 div + 0.6 mV)			
	Delta Volts between any two samples[2]	±(1.0% × reading + 0.26 div + 1.2 mV)			
Frequency Limit, Upper, 100 MHz Bandwidth Limited (CH 1 and CH 2 only)	100 MHz				
Frequency Limit, Upper, 20 MHz Bandwidth Limited (CH 1 and CH 2 only)	20 MHz				
Nonlinearity	< 1 DL, differential; ≤ 1 DL, integral, independently based				
Step Response Settling Errors (CH 1 and CH 2 only)	**Volts/Div Setting**	**Step Amplitude**	**Settling Error (%)[3]**		
			20 ns	**100 ns**	**20 ms**
	1 mV/div–99.5 mV/div	≤2 V	≤0.5	≤0.2	≤0.1
	100 mV/div–995 mV/div	≤20 V	≤1.0	≤0.5	≤0.2
	1 V/div–10 V/div	≤200 V	≤1.0	≤0.5	≤0.2

[1]Net Offset = Offset – (Position x Volts/Div). Net Offset is the voltage level at the center of the A-D converter's dynamic range. Offset Accuracy is the accuracy of this Voltage level.

[2]The samples must be acquired under the same setup and ambient conditions.

[3]The values given are the maximum absolute difference between the value at the end of a specified time interval after the mid-level crossing of the step, and the value one second after the mid-level crossing of the step, expressed as a percentage of the step amplitude.

Table 1-14: Typical Characteristics – Time Base System

Name	Description
Aperture Uncertainty	≤(50 ps + 0.03 ppm × Record Duration) rms, for real-time or interpolated records having duration ≤1 minute; ≤(50 ps + 0.06 × WI[1]) rms, for equivalent time records

[1]The WI (waveform interval) is the time between the samples in the waveform record. Also, see the footnotes for *Sample Rate Range* and *Equivalent Time or Interpolated Waveform Rates* in Table 1-3 on page 1-8.

Table 1-15: Typical Characteristics — Triggering System

Name	Description	
Input, Auxiliary Trigger	The input resistance is ≥1.5 kΩ; the maximum safe input voltage is ±20 V (DC + peak AC).	
Error, Trigger Position, Edge Triggering	**Acquire Mode**	**Trigger-Position Error[1,2]**
	Sample, Hi-Res, Average	±(1 WI + 1 ns)
	Peak Detect, Envelope	±(2 WI + 1 ns)
Holdoff, Variable, Main Trigger	Minimum: For any horizontal scale setting, the *minimum* holdoff is 10 times that setting, but is never shorter than1 µs or longer than 5 s. Maximum: For any horizontal scale setting, the *maximum* holdoff is at least 2 times the minimum holdoff for that setting, but is never greater than 10 times the minimum holdoff for that setting.	
Lowest Frequency for Successful Operation of "Set Level to 50%" Function	50 Hz	
Sensitivity, Edge Trigger, Not DC Coupled[3]	**Trigger Coupling**	**Typical Signal Level for Stable Triggering**
	AC	Same as DC-coupled limits[4] for frequencies above 60 Hz. Attenuates signals below 60 Hz.
	Noise Reject	Three and one half times the DC-coupled limits.[4]
	High Frequency Reject	One and one half times times the DC-coupled limits[4] from DC to 30 kHz. Attenuates signals above 30 kHz.
	Low Frequency Reject	One and one half times the DC-coupled limits[4] for frequencies above 80 kHz. Attenuates signals below 80 kHz.
Sensitivities, Logic Trigger/Pulse Trigger/ Events, DC Coupled[5]	1.0 division, from DC to 100 MHz with a minimum slew rate of 25 div/µs at the trigger level or the threshold crossing	
Width, Minimum Pulse and Rearm, for Logic Triggering or Events Delay[6]	5 ns	

[1]The trigger position errors are typically less than the values given here. These values are for triggering signals having a slew rate at the trigger point of ±0.5 division/ns.

[2]The waveform interval (WI) is the time between the samples in the waveform record. Also, see the footnote for the characteristics *Sample Rate Range* and *Equivalent Time or Interpolated Waveform Rates* in Table 1-3 on page 1-8.

[3]The minimum sensitivity for obtaining a stable trigger. A stable trigger results in a uniform, regular display triggered on the selected slope. The trigger point must not switch between opposite slopes on the waveform, and the display must not "roll" across the screen on successive acquisitions. The TRIG'D LED stays constantly lighted when the SEC/DIV setting is 2 ms or faster but may flash when the SEC/DIV setting is 10 ms or slower.

[4]See the characteristic *Sensitivity, Edge-Type Trigger, DC Coupled* in Table 1-10, which begins on page 1-14.

[5]The minimum signal levels required for stable logic or pulse triggering of an acquisition or for stable counting of a DC coupled events delay signal. Also, see the footnote for *Sensitivity, Edge-Type Trigger, DC Coupled* in this table. (Stable counting of events is counting that misses no events.)

[6]The minimum pulse width and rearm width required for logic-type triggering or events delaying to occur.

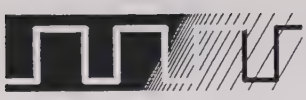
Table 1-16: Typical Characteristics -- Data Handling and Reliability

Name	Description
Time, Data-Retention, Nonvolatile Memory[1,2]	5 years
Mean Time Between Failures (MTBF)[3]	10,000 hours at 50°C; 12,600 hours at 40°C; 18,300 hours at 25°C. An average activation energy of 0.2 eV is assumed.

[1]The time that reference waveforms, stored setups, and calibration constants are retained when there is no power to the digitizing oscilloscope.

[2]Data is maintained by small lithium-thionyl-chloride batteries internal to the memory ICs. The amount of lithium is so small in these ICs that they can typically be safely disposed of with ordinary garbage in a sanitary landfill.

[3]The average length of time between successive failures, calculated by summing the failure rates of all components and connections in the instrument and taking the reciprocal of that sum.



Operating Information

Replace this page with the tab divider of the same name.

Using this Manual

This section contains information needed to properly use this manual to service the TDS 520 Digitizing Oscilloscope, as well as general information critical to safe and effective servicing of this oscilloscope.

Before Servicing

This manual is for servicing the TDS 520 Digitizing Oscilloscope. To prevent injury to yourself or damage to the oscilloscope, do the following before you attempt service:

- Be sure you are a qualified service person;
- Read the Operators and Service Safety Summaries found at the beginning of this manual;
- Read *Strategy for Servicing* and *Supplying Operating Power* in this section.

When using this manual for servicing, be sure to heed all warnings, cautions, and notes.

Strategy for Servicing

Throughout this manual, any field-replaceable component, assembly, or part of this digitizing oscilloscope is referred to generically as a module.

This manual contains all the information needed for periodic maintenance of the TDS 520 Digitizing Oscilloscope. (Examples of such information are procedures for checking performance and for readjustment.) Further, it contains all information for corrective maintenance down to the module level. This means that the procedures, diagrams, and other troubleshooting aids help isolate failures to a specific module, rather than further to components of that module. Once a failure is isolated, replace the module with a fresh unit obtained from the factory.

All modules are listed in Section 10, *Replaceable Parts.* To isolate a failure to a module, use the fault isolation procedures found in Section 6, *Maintenance.* To remove and replace any failed module, follow the instructions in *Removal and Installation Procedures*, also found in Section 6.

Manual Structure

This manual is divided into sections, such as *Specification, Theory of Operation*. Further, it is divided into subsections, such as *Product Description* and *Removal and Installation Procedures.*

Sections containing procedures also contain introductions to those procedures. Be sure to read these introductions, because they provide information needed to perform the service correctly and efficiently. The following is a brief description of each manual section.

- *Specification* — contains a product description of the TDS 520 Digitizing Oscilloscope and tables of the characteristics and descriptions that apply to it.
- *Operating Information* — is this section. It includes a description of how this manual is structured, as well as general information and operating instructions at the level needed to safely power up and service this oscilloscope. A statement of the service strategy that this manual supports, and instructions for shipment of the digitizing oscilloscope are found in this section.
- *Theory of Operation* — contains circuit descriptions that support general service and fault isolation.
- *Performance Verification* — contains a collection of procedures for confirming that this digitizing oscilloscope functions properly and meets warranted limits.
- *Adjustment Procedures* — contains a collection of procedures for adjusting this digitizing oscilloscope to meet warranted limits.
- *Maintenance* — contains information and procedures for doing preventive and corrective maintenance of this digitizing oscilloscope. Instructions for cleaning, for module removal and installation, and for fault isolation to a module are found here.
- *Options* — contains information on servicing any of the factory-installed options that may be present in your digitizing oscilloscope.
- *Electrical Replaceable Parts* — contains a statement referring you to *Replaceable Parts,* where both electrical and mechanical modules are listed. See below.
- *Diagrams* — contains a collection of diagrams, illustrations, and charts useful for isolating failed modules.
- *Replaceable Parts* — includes a table of all replaceable modules, their descriptions, and their Tektronix part numbers.

Manual Conventions

This manual uses certain conventions which you should become familiar with before doing service.

Modules

Throughout this manual, any replaceable component, assembly, or part of this digitizing oscilloscope is referred to generically as a module. In general, a module is an assembly, like a circuit board, rather than a component, like a resistor or an integrated circuit. Sometimes a single component is a module; for example, each chassis part of the oscilloscope is a module.

Safety

Symbols and terms related to safety appear in the Operators and Service Safety Summaries found at the beginning of this manual.

Symbols

Besides the symbols related to safety, this manual uses the following symbols:

The "stop sign" icon labels information which must be read in order to correctly do service and to avoid incorrectly using or applying service procedures.

The clock icon labels procedure steps which require a pause to wait for the oscilloscope to complete some operation before you can continue.

Various icons such as the example icon at the left are used in procedures to help identify certain readouts and menu functions on screen.

Tektronix Service

Tektronix provides service to cover repairs under warranty as well as other services that may provide a cost-effective answer to your service needs.

Whether providing warranty repair service or any of the other services listed below, Tektronix service technicians, trained on Tektronix products, are best equipped to service your TDS 520 Digitizing Oscilloscope. Tektronix technicians are appraised of the latest information on improvements to the product as well as the latest new options to the product.

Warranty Repair Service

Tektronix warrants this product for three years from date of purchase. Tektronix technicians provide all warranty service at most Tektronix service locations worldwide. Contact the Tektronix service depot nearest you for more information.

Repair or Adjustment Service

The following services may be purchased to tailor repair and/or adjustment of your TDS 520 Digitizing Oscilloscope to fit your requirements.

Option 9C – When you order your TDS 520 Digitizing Oscilloscope with option 9C, it is shipped with a *Certificate of Calibration and Test Data.* This certificate provides traceability to the National Institute of Standards and Technology (NIST), which is required for compliance with Military Standard 45662A.

Customer and Repair Service – Tektronix offers several standard-priced adjustment (calibration) and repair services:

- Single repair or adjustment.
- Adjustments using equipment and procedures that meet the traceability standards specific to the local area.
- Annual maintenance agreements that provide for either yearly adjustment and repair or yearly adjustment only of the oscilloscope.

Of these services, the annual maintenance agreement offers a particularly cost-effective approach to service for many owners of the TDS 520 Digitizing Oscilloscope. Such agreements can be purchased to span several years.

On-Site Service – The annual maintenance agreement can be purchased with on-site service, with repair and adjustment done at your facility. This service reduces the time your oscilloscope is out of service when adjustment or repair is required.

Self Service

Tektronix supports repair to the module level by providing *Module Exchange* and *Module Repair and Return.*

Module Exchange – This service reduces down time for repair by allowing you to exchange most modules for remanufactured ones. Tektronix ships you an updated and tested exchange module from the Beaverton, Oregon service center within 24 hours. Each module comes with a 90-day service warranty.

Module Repair and Return – This service returns to you within 10 days the same module that you shipped to Tektronix. The module shipped is repaired, tested, and returned to you from the Beaverton, Oregon service center. It is *not* updated to match current modules of the same type. Again, each module comes with a 90-day service warranty.

For More Information – Contact your local Tektronix service center or sales engineer for more information on any of the repair or adjustment services just described.

Finding Other Information

The TDS 520 Digitizing Oscilloscope comes with the following manuals:

TDS 520 and TDS 540 Tutorial/User Manual contains a tutorial to quickly show you how to operate the TDS 520 Digitizing Oscilloscope; and an in depth discussion of how to more completely use its features. Applications are also discussed.

TDS 520 and TDS 540 Quick Reference contains a brief overview of oscilloscope operation.

TDS Family Programmer Manual contains information for programmed operation via the GPIB interface. Included is the complete command set, set up information, and programming examples.

Supplying Operating Power

Read all information and heed all warnings in this subsection before connecting the TDS 520 Digitizing Oscilloscope to a power source.

WARNING

AC POWER SOURCE AND CONNECTION. The TDS 520 Digitizing Oscilloscope *operates from a single-phase power source. It has a three-wire power cord and two-pole, three-terminal grounding type plug. The voltage to ground (earth) from either pole of the power source must not exceed the maximum rated operating voltage, 250 volts.*

Before making connection to the power source, be sure the TDS 520 has a suitable two-pole, three-terminal grounding-type plug.

GROUNDING. This instrument is safety Class 1 equipment (IEC designation). All accessible conductive parts are directly connected through the grounding conductor of the power cord to the grounded (earthing) contact of the power plug.

WARNING

The power input plug must be inserted only in a mating receptacle with a grounding contact where earth ground has been verified by a qualified service person. Do not defeat the grounding connection. Any interruption of the grounding connection can create an electric shock hazard.

For electric shock protection, the grounding connection must be made before making connection to the instrument's input or output terminals.

Power Cord Information

A power cord with appropriate plug configuration is supplied with each TDS 520 Digitizing Oscilloscope. Table 2-1 gives the color-coding of the conductors in the power cord. If you require a power cord other than the one supplied, refer to Table 2-2, *Power-Cord and Plug Identification*.

Table 2-1: Power-Cord Conductor Identification

Conductor	Color	Alternate Color
Ungrounded (Line)	Brown	Black
Grounded (Neutral)	Light Blue	White
Grounded (Earthing)	Green/Yellow	Green

Operating Voltage

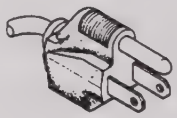
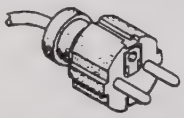
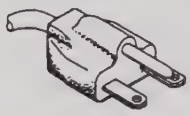
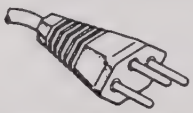
This oscilloscope operates with any line voltage from 90-250 VAC rms with any line frequency from 47-63 Hz. There are two fuses, either of which may be used throughout the line voltage and frequency ranges. (The two fuses are not totally interchangeable as each requires a different fuse cap.)

Memory Backup Power

Memory modules with on-board batteries allow the TDS 520 Digitizing Oscilloscope to retain some types of data upon loss of the AC power source. The stored adjustment constants, saved front-panel settings, current front-panel settings (instrument status), and waveforms saved in memory are retained.

The on-board batteries of the memory modules have a shelf life of about five years. Partial or total loss of stored settings upon power-up may indicate that the memory modules need to be replaced.

Table 2-2: Power-Cord and Plug Identification

Plug Configuration	Usage (Max Rating)	Reference Standards & Certification	Option #
	North America 125 V/6 A	ANSI C73.11[1] NEMA 5-15-P[2] IEC 83[3] UL[10] CSA[11]	Standard
	Europe 220 V/16 A	ICE 83[3] CEE (7), II, IV, VII[4] VDE[8] SEMKO[9]	A1
	United Kingdom 240 V/13 A	IEC 83[3] BSI 1363[5]	A2
	Australia 240 V/10 A	AS C112[6] ETSA1[2]	A3
	North America 240 V/15 A	ANSI C73.20[1] NEMA 6-15-P[2] IEC 83[3] UL[10] CSA[11]	A4
	Switzerland 220 V/10 A	SEV[7]	A5

[1]ANSI — American National Standards Institute
[2]NEMA — National Electrical Manufacturers' Association
[3]IEC — International Electrotechnical Commission
[4]CEE — International Commission on Rules for the Approval of Electrical Equipment
[5]BSI — British Standards Institute
[6]AS — Standards Association of Australia
[7]SEV — Schweizevischer Elektrotechischer Verein
[8]VDE — Verband Deutscher Elektrotechniker
[9]SEMKO — Swedish Institute for Testing and Approval of Electrical Equipment
[10]UL — Underwriters Laboratories
[11]CSA — Canadian Standards Association
[12]ETSA — Electricity Trust of South Australia

Operating Environment

The following environmental requirements are provided to ensure proper operation and long instrument life.

Operating Temperature

The TDS 520 Digitizing Oscilloscope can be operated where the ambient air temperature is between 0° and +50°C and can be stored in ambient temperatures from −40° to +75°C. After storage at temperatures outside the operating limits, allow the chassis to stabilize at a safe operating temperature before applying power.

Ventilation Requirements

The TDS 520 Digitizing Oscilloscope is cooled by air drawn in and exhausted through its cabinet side panels by an internal fan. To ensure proper cooling of the instrument, allow at least two inches clearance on both sides and ¾ inch on the bottom of the digitizing oscilloscope. (The feet on the bottom of the oscilloscope provide the required clearance when set on flat surfaces.) The top of the oscilloscope does not require ventilation clearance.

CAUTION

If air flow is restricted, the digitizing oscilloscope's power supply may temporarily shut down.

Applying and Interrupting Power

Consider the following information when you power up or power down the instrument, or when power is interrupted due to an external power failure.

Power-Up

Upon power-up, the oscilloscope runs its power-on self check. If it passes, the oscilloscope displays a "passed" status message and a prompt to press CLEAR MENU to continue. If it fails, the oscilloscope displays a diagnostic log that identifies the area(s) that failed and a prompt to press CLEAR MENU to continue. See Section 6, *Maintenance*, for information on diagnostics and fault isolation.

Power Down

CAUTION

DO NOT power down the oscilloscope when either running a signal path compensation or when doing any of the adjustments described in Section 5, Adjustment Procedure. *To do so might result in the loss of internally stored adjustment constants.*

In general, do not power down the instrument when doing operations that affect the data types listed in Table 2-3. Wait for the instrument to finish the operation when doing adjustments, saving waveforms, or saving setups.

Improper power-down or unexpected loss of power to the oscilloscope can result in the following corruptions of non-volatile RAM (NVRAM). The following table describes the messages displayed when power is restored after an abnormal power-down.

Table 2-3: Effects of Corrupted Data

Corrupted Data Type	Results
Adjustment Constants:	
■ Signal Path Compensation	A signal path compensation is required.
■ Controlled Voltage Reference (CVR)	A CVR adjustment is required (Section 5).
■ Clock Interleave	A Clock Interleave adjustment is required (Section 5).
Error Log	Errors logged are lost.
Reference Waveforms	Waveform Lost.
Saved Setups	Setup Lost.

Repackaging Instructions

Use a corrugated cardboard shipping carton having a test strength of at least 275 pounds and with an inside dimension at least six inches greater than the instrument dimensions.

If the instrument is being shipped to a Tektronix Service Center, enclose the following information: the owner's address, name and phone number of a contact person, type and serial number of the instrument, reason for returning, and a complete description of the service required.

Seal the shipping carton with an industrial stapler or strapping tape.

Mark the address of the Tektronix Service Center and also your own return address on the shipping carton in two prominent locations.

Installed Options

Your instrument may be equipped with one or more instrument options. Except for the line-cord options described by Table 2-2 (on page 2-9 of this section), all options and optional accessories are listed and described in Section 7, *Options*. For further information and prices of instrument options, see your Tektronix Products catalog or contact your Tektronix Field Office.

General Operating Instructions

Before doing service, read the following operating instructions. These instructions are at the level appropriate for servicing this digitizing oscilloscope. The complete operators instructions are found in the *Tutorial/User Manual*.

Additional instructions are integrated into the service procedures found in later sections of this manual. For instance, the procedures found in the section *Performance Verification* contain instructions for making the front-panel settings required to check each instrument characteristic included there. Also, the general instructions for operating this digitizing oscilloscope's internal diagnostic routines are found in Section 6, *Maintenance*. You may also find the *Product Description* in Section 1 useful for understanding how the oscilloscope functions.

Screen Layout

The screen layout is illustrated in Figure 2-1 on page 2-14. Note that the figure illustrates a full graticule; you may also select a grid, crosshair, or frame graticule from the display menu.

Basic Procedures

How to Power Up

Push the power switch found at the back of the digitizing oscilloscope, then push the **ON/STBY** (standby) switch to toggle the digitizing oscilloscope into operation. The switch at the rear panel is the true power disconnect switch. The **ON/STBY**(standby) switch simply toggles operation on and off.

WARNING

The power switch at the rear panel is the true power disconnect switch. The **ON/STBY** *(standby) switch simply toggles operation on and off. When connected to a power source and when the rear-panel power switch is on, the internal power supplies and much of the other circuitry of this digitizing oscilloscope are energized regardless of the setting of the* **ON/STBY** *switch.*

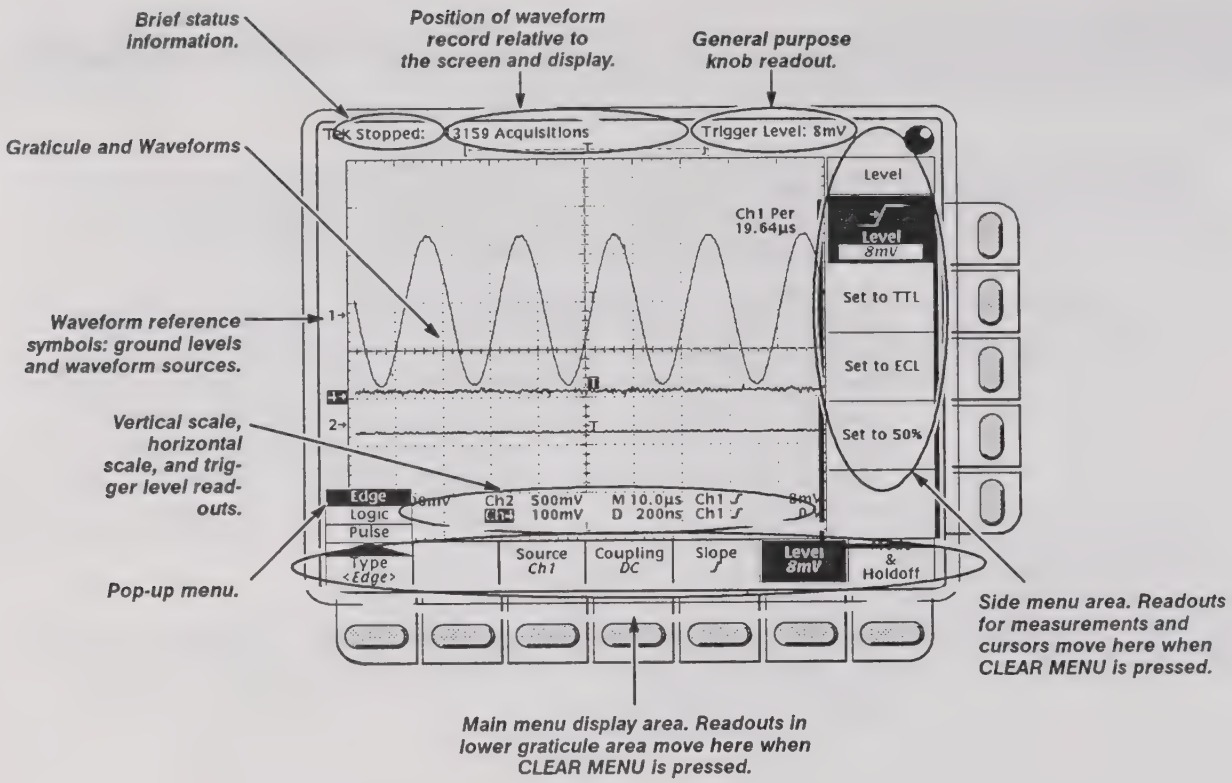


Figure 2-1: Map of Display Functions

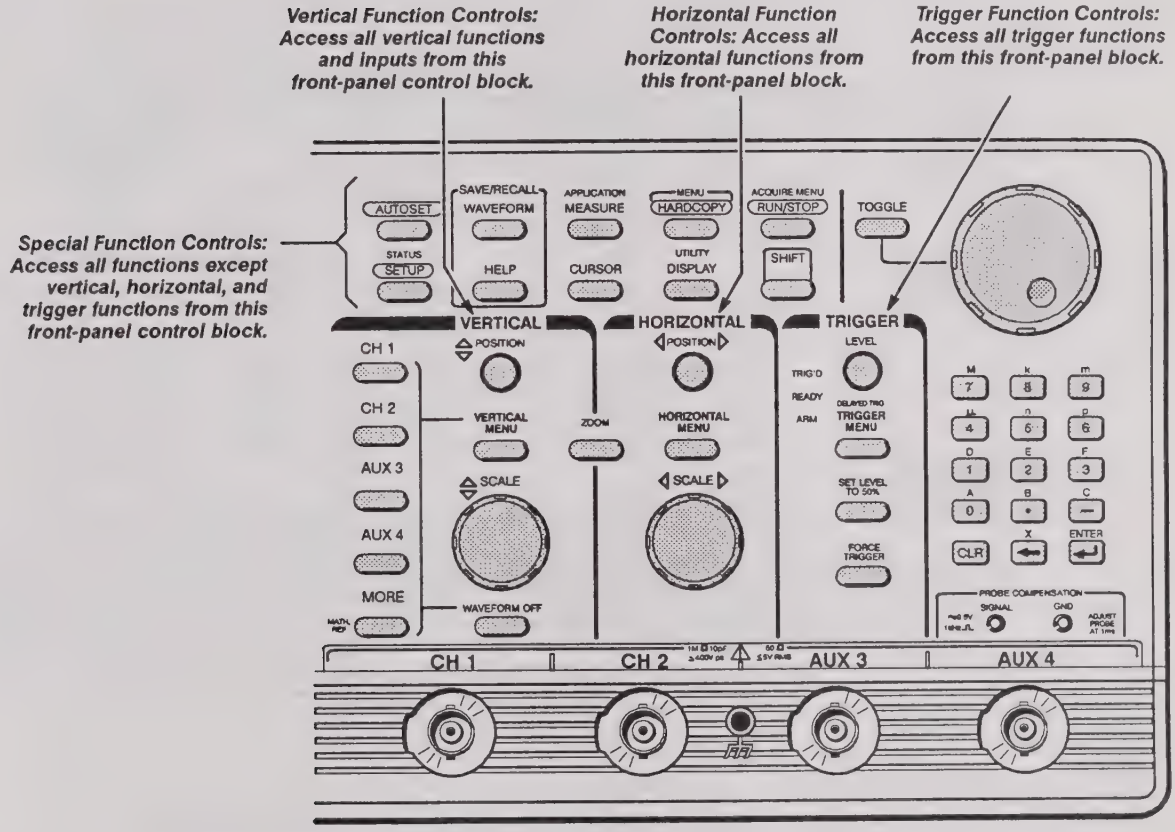
How to Use Help – Push the **HELP** front-panel button to enter help mode. Front-panel knobs and buttons now display information about their function when turned or pushed. Push **HELP** again to exit help mode.

To get help information on a menu item, display the menu desired (if you are in help mode, exit help first). Push **HELP**. Now the menu buttons display information about their function when pushed.

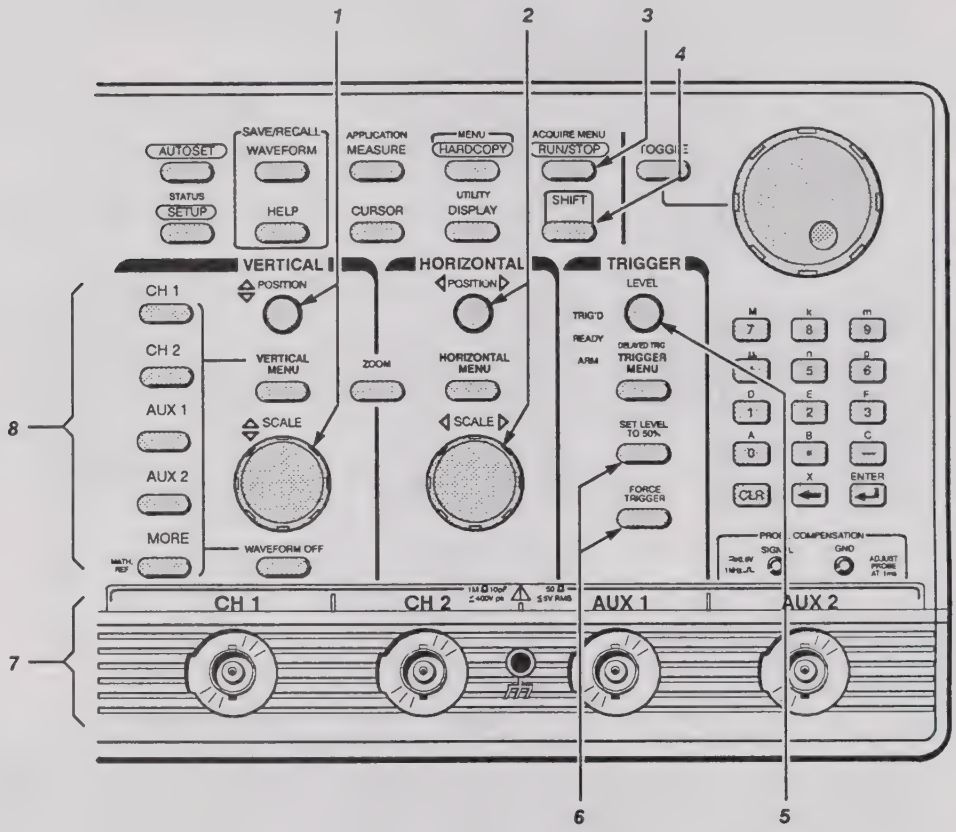
How to Use the Status Menu – Push the **SHIFT**, then **HELP** front-panel buttons to display the status menu. You will find messages reflecting the state of the acquisition system, whether it is running or stopped (and if it is stopped, why), as well as setup-related information.

How to Set Functions – Most functions can be set either by using one or two front-panel buttons or knobs, or by pushing a front-panel button to use a main menu, and then a side menu to set the function. The following steps illustrate both procedures.

1. Locate the block that contains the function to be set.



2. Select the waveform source(s). Position, scale, and set trigger level for waveform source(s) directly from the front-panel. (Examples of possible control selections are given in the steps that follow.)



a. Input waveforms into these channels (7). Example: **CH 1**.

b. Push any channel's button (8) to display its waveform. The last channel turned on determines which waveform is positioned and scaled in the next substep. The indicator above the channel last selected is lighted. Example: Push **CH 1**; then **CH 2**.

c. Vertically (1) and horizontally (2) scale and position the waveform(s) selected. Example: Set to scale to 100 mV/div and center the waveform on screen.

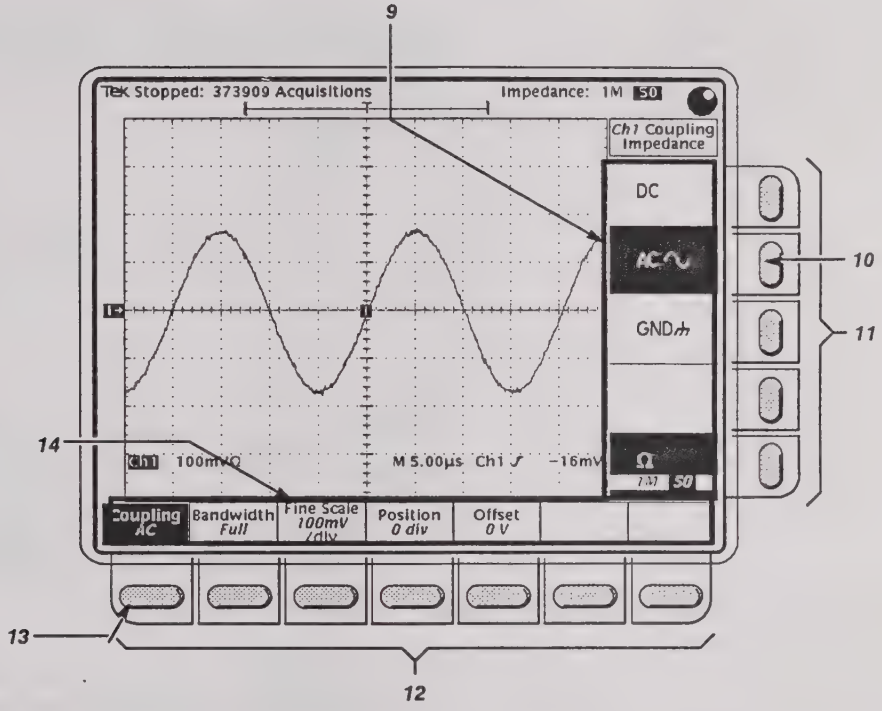
d. Stop and start acquiring waveforms (3). Example: Push **RUN/STOP** if not acquiring.

e. Adjust trigger level (5) to trigger the waveform(s) selected or use these buttons (6) to either set a trigger level at the mid-amplitude level of the selected waveform or to force a single trigger. Example: Push **SET LEVEL TO 50%**.

3. Set all other functions using menus.

   a. Choose the waveform source (8) first if setting a vertical function; else skip to step b. Example: Push **CH 2**.

   b. Push **SHIFT** (4) if the function to be set is highlighted in blue; else skip to step c.



   c. Push the front-panel button that corresponds to the menu containing the function. A main menu (14) for selecting among related functions appears. Example: Push **VERTICAL MENU**.

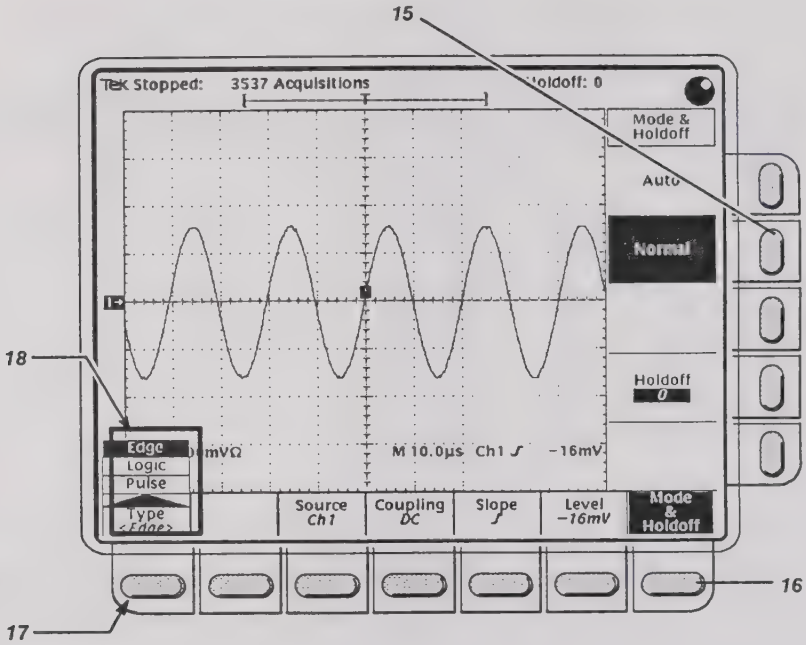
      Note the two labels: the top label is a function to choose from; the bottom label tells you the current setting for that function. **Offset** is currently set to ***0 V***.

   d. Select a function from the main menu using the main menu buttons (12). A side menu for selecting among that the available settings for that function appears. Example: Push **Coupling** (13).

   e. Select the setting for the function from the side menu (9) using the side menu buttons (11). Example: Push **AC** (10).

How to Set Complex Functions – A few functions require more than just two levels (main and side) of menus to completely specify their settings. In such cases, either the main menu, the side menu, or both are modified to supply additional choices. The procedures that follow show both schemes.

1. Set up a function using pop-up menus:



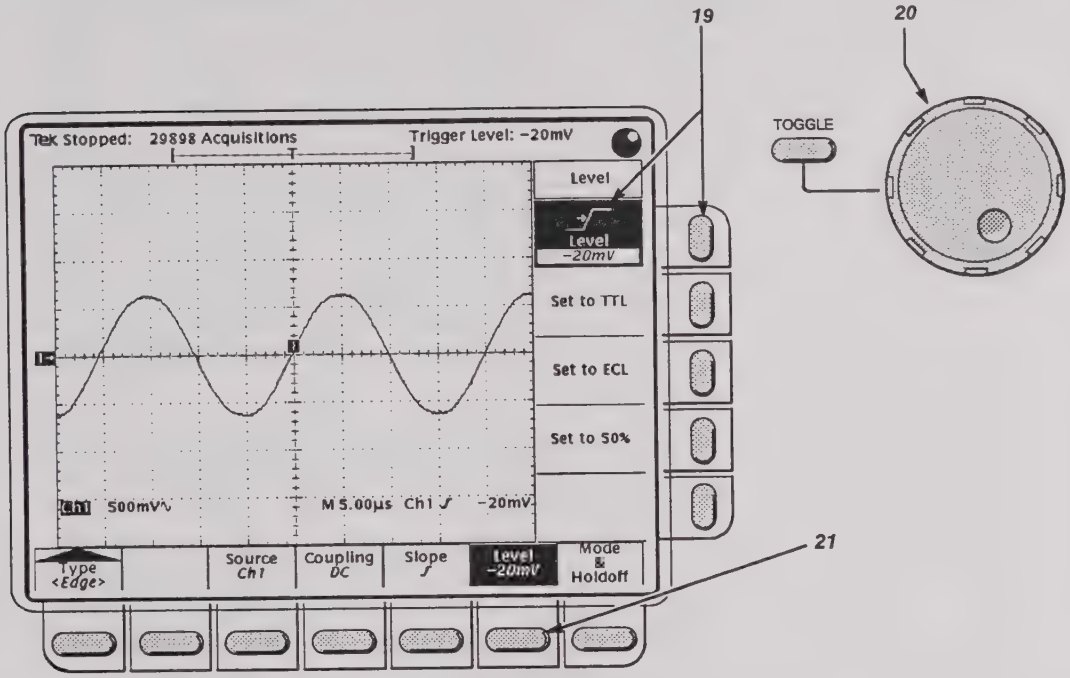
   a. For some selections, pushing a main menu button pops up a menu (18) of subfunctions. Example: Push **Type** (17).

      Note the pop-up menu for **Type** is set to **Edge**. All the main menu buttons to the right of the pop-up menu are labeled with subfunctions of **Edge**.

   b. Pushing the button that popped up the menu (17) toggles through the pop-up menu choices. Example: Repeatedly push **Type** to toggle through the pop-up menu. Notice the other main-menu button labels change accordingly. Toggle back to **Edge**.

   c. Complete the setting of the desired mode by selecting from the main menu and the side menu that results. Example: Push **Mode & Holdoff** (16), and then push **Normal** (15).

2. Set up a function using the general purpose knob (20). (The examples of possible menu selections in substeps that follow assume you've pushed **TRIGGER MENU**.)



a. Pushing some main menu buttons displays a side menu with labels containing readouts that can be varied. Example: Push **Level** (21).

b. Pushing the side-menu button assigns the knob to control the readout appearing in the button label. It also copies the readout to the general purpose knob readout area in the right corner of the screen. Example: Push **Level** (19).

c. Use the general purpose knob (20) to adjust the trigger level to the setting desired. Example: Turn the knob to **-20 mV**.

More About the General Purpose Knob – As you've just seen, the general purpose knob can be used to extend the number of choices available to a side menu button. The general purpose knob can also be assigned to control the following functions:

- Cursor positioning
- Display intensities
- Delay time
- Number of events
- Trigger position
- Holdoff

- Offset
- Variable persistence

In all cases, the menus are used to select the function to which the general purpose knob is assigned. The following attributes apply to this knob:

- Depending on the function it is assigned to control, the general purpose knob may vary numerical readouts, position objects (cursors) on screen, or select between icon-label settings that show up in side-menu labels.
- The general purpose knob has a readout area at the upper right corner of the screen. (See Figure 2-1.) This readout always reflects the name and value of the function that the general purpose knob is currently controlling.
- Whenever the general purpose knob assignment is changed, a knob icon appears immediately to the left of the general purpose knob readout to notify you of the assignment change. The icon is removed as soon as you use the general purpose knob to change the value of the function it is assigned to.
- To assign the general purpose knob to control a function, display the menu containing the function; then select the function. (Note not all functions can be controlled by the general purpose knob.)
- Whenever the menu is removed, the general purpose knob is not assigned and doesn't control any function. (An exception is the cursor function. If cursors are turned on, removing the menu leaves the knob assigned to control the cursors until reassigned by selecting another menu and function that uses the knob.)
- The general purpose knob also has a **TOGGLE** button. The toggle button is used to toggle the knob between the control of either of the two cursors displayed when H-bar or V-bar cursors are turned on in the cursor menu.

Display and Utility Menus – Using the techniques described for using menus, you can access and change functions in the display menu and utilities menu. In the Display menu, you can set the following functions:

- Intensity: waveforms, readouts, graticule, etc.
- Style of waveform display(s): vectors or dots, intensified or non-intensified samples, and infinite or variable persistence.
- Display format: XY or YT.
- Graticule format: type.
- Waveform interpolation filter and readout options.

From the Utility menu, you can configure the GPIB port (talk/listen, address, etc.) and access internal routines for self diagnostics and self compensation. Instructions for setting up communication over the GPIB are found in Section 5, *Adjustment Procedures*; for using self-diagnostics, in Section 6, *Maintenance*.

Theory of Operation

Replace this page with the tab divider of the same name.

Circuit Description

This section describes the electrical operation of the Tektronix TDS 520 Digitizing Oscilloscope using the major circuit blocks or modules.

This section has two main parts:

- **Logic Conventions** describes how logic functions are discused and represented in this manual.
- **Module Overview** describes circuit operation from a functional-circuit block perspective.

Logic Conventions

The TDS 520 Digitizing Oscilloscope contains many digital logic circuits. This manual refers to these circuits with standard logic symbols and terms. Unless otherwise stated all logic functions are described using the positive-logic convention: the more positive of the two logic levels is the high (1) state, and the more negative level is the low (0) state. Signal states may also be described as "true" meaning their active state or "false" meaning their non-active state. The specific voltages that constitute a high or low state vary among the electronic devices.

Active-low signals are indicated by a tilde prefixed to the signal name (~RESET). Signal names are considered to be either active-high, active-low, or to have both active-high and active-low states.

Module Overview

This module overview describes the basic operation of each functional circuit block as shown in Figure 9-2 .

General

The Tektronix TDS 520 Digitizing Oscilloscope is a portable, four-channel instrument suitable for use in a variety of test and measurement applications and systems. It has two full-featured channels, plus two auxiliary channels.

Input Signal Path

A signal enters the oscilloscope through a probe connected to a BNC on the A15 Attenuator board.

Attenuators – Circuitry in the attenuator selects the input coupling, termination, and the attenuation factor. The processor system, by way of the acquisition system, controls the attenuators. For example, if 50 Ω input termination is selected and the input is overloaded, the processor system switches the input to the 1 MΩ position.

Probe Coding Interface – Probe coding interface signals pass through the A15 Attenuator to the acquisition system, where they are sensed and controlled.

Acquisition System – The acquisition system amplifies the input signals, converts them to digital signals, and controls the acquisition process under direction of the processor system. The acquisition system includes the trigger, acquisition timing, and acquisition mode generation and control circuitry.

D1 Bus – The acquisition system passes the digital values representing the acquired waveform through the A14 D1 Bus to the A11 DRAM Processor/Display board. This happens after a waveform acquisition is complete if the digital signal processor in the processor system requests the waveform.

Processor System – The processor system contains a 68020 microprocessor that controls the entire instrument. It also includes a GPIB interface and a digital signal processor. The digital signal processor processes each waveform as directed by software downloaded from the A13 Firmface by the system processor. Waveforms and any text to be displayed are passed on to the display system. The A11 DRAM Processor/Display board contains both the processor and display systems.

Display System – Text and waveforms are processed by different parts of the display circuitry. The display system sends the text and waveform information to the tube assembly as a video signal. The display system also generates and sends vertical (VSYNC) and horizontal (HSYNC) sync signals to the tube assembly.

Voltage Controlled Oscillator (VCO)

Master clocks for the acquisition system are generated by a voltage controlled oscillator on the A21 VCO Board and circuitry on the A10 Acquisition board. The circuitry makes up a phased locked loop. The master clock is divided down by the A10 Acquisition circuitry under control of the processor system.

Firmface

The A13 Firmface contains the firmware program for the oscilloscope. The firmware can be reprogrammed by reburning the ROMs using the GPIB and an external software package.

Tube Assembly

All information (waveforms, text, graticules, and pictographs) is displayed by the A20 CRT Driver. It generates the high voltages necessary to drive the CRT. It also contains the video amplifier, horizontal oscillator, and the vertical and horizontal yoke driver circuitry.

Front Panel

The processor system sends instructions to and receives information from the Front Panel Processor on the A12 Front Panel board. The Front Panel Processor reads the front-panel switches and pots. Any changes in their settings are reported to the processor system. The Front Panel Processor also turns the LEDs on and off and generates the bell signal.

Front-panel menu switches are also read by the Front Panel Processor. The processor sends any changes in menu selections to the processor system. The **ON/STBY** switch is one of the menu switches. However, it is not read by the Front Panel Processor, but passes through the A12 Front Panel board and the A11 DRAM Processor/Display board to the low voltage power supply.

The front panel also generates the probe compensation signals **SIGNAL** and **GND**.

Rear Panel

The **GPIB** connector provides access to stored waveforms, and allows external control of the oscilloscope.

Low Voltage Power Supply

The low voltage power supply is a switching power converter with active power factor control. It supplies power to all of the circuitry in the oscilloscope.

The principal **POWER** switch, located on the rear panel, controls all power to the oscilloscope including the Low Voltage Power Supply. The **ON/STBY** switch, located on the front panel, also controls all of the power to the oscilloscope except for part of the circuitry in the Low Voltage Power Supply.

The power supply sends a power fail (~PF) warning to the processor system if the power is going down.

Fan

The fan provides forced air cooling for the oscilloscope. It connects to +25 V from the Low Voltage Power Supply by way of the A11 DRAM Processor/Display module.

Brief Procedures

The *Self Tests* use internal routines to confirm basic functionality and proper adjustment. No test equipment is required to do these test procedures.

The *Functional Tests* utilize the probe-compensation output at the front panel as a test-signal source for further verifying that the oscilloscope functions properly. A standard-accessory probe, included with this oscilloscope, is the only equipment required.

General Instructions

Besides the *Brief Procedures,* the set of procedures that can be used to verify oscilloscope performance includes the *Performance Tests,* found later in this section. You may not need to perform all of these procedures, depending on what you want to accomplish:

- To rapidly confirm that this oscilloscope functions and was adjusted properly, just do the procedures under *Self Tests*, which begin on page 4-4.

  Advantages: These procedures are quick to do, require no external equipment or signal sources, and perform extensive functional and accuracy testing to provide high confidence that the oscilloscope will perform properly. They can be used as a quick check before making a series of important measurements.

- To further check functionality, first do the *Self Tests* just mentioned; then do the procedures under *Functional Tests* that begin on page 4-6.

  Advantages: These procedures require minimal additional time to perform, require no additional equipment other than a standard-accessory probe, and more completely test the internal hardware of this oscilloscope. They can be used to quickly determine if the oscilloscope is suitable for putting into service, such as when it is first received.

- If more extensive confirmation of performance is desired, do the *Performance Tests*, beginning on page 4-11, after doing the *Functional* and *Self Tests* just referenced.

  Advantages: These procedures add direct checking of warranted specifications. They require more time to perform and suitable test equipment is required. (See *Equipment Required* on page 4-11.)

If you are not familiar with operating this oscilloscope, read *General Operating Instructions* in Section 3 of this manual. These instructions will acquaint you with the use of the front-panel controls and the menu system.

Conventions

Throughout these procedures the following conventions apply:

- Each test procedure uses the following general format:

  Title of Test

  Equipment Required

  Prerequisites

  Procedure

- Each procedure consists of as many steps, substeps, and subparts as required to do the test. Steps, substeps, and subparts are sequenced as follows:

1. First Step
   a. First Substep
      - First Subpart
      - Second Subpart
   b. Second Substep
2. Second Step

- In steps and substeps, the lead-in statement in italics instructs you what to do, while the instructions that follow tell you how to do it: in the example step below, *"Initialize the oscilloscope"* by doing "Press save/recall **SETUP**. Now, press the main-menu button...."

  Initialize the oscilloscope: Press save/recall **SETUP**. Now, press the main-menu button **Recall Factory Setup**; then the side-menu button **OK Confirm Factory Init**.

- Where instructed to use a front-panel button or knob, or select from a main or side menu, or verify a readout or status message, the name of the button or knob appears in boldface type: "press **SHIFT**; then **ACQUIRE MENU**," "press the main-menu button **Coupling**," or "verify that the status message is ***Pass***.

The symbol at the left is accompanied by information you must read to do the procedure properly.

- Refer to Figure 4-1: "Main menu" refers to the menu that labels the seven menu buttons under the display; "side menu" refers to the menu that labels the five buttons to the right of the display. "Pop-up menu" refers to a menu that pops up the when a main-menu button is pressed.

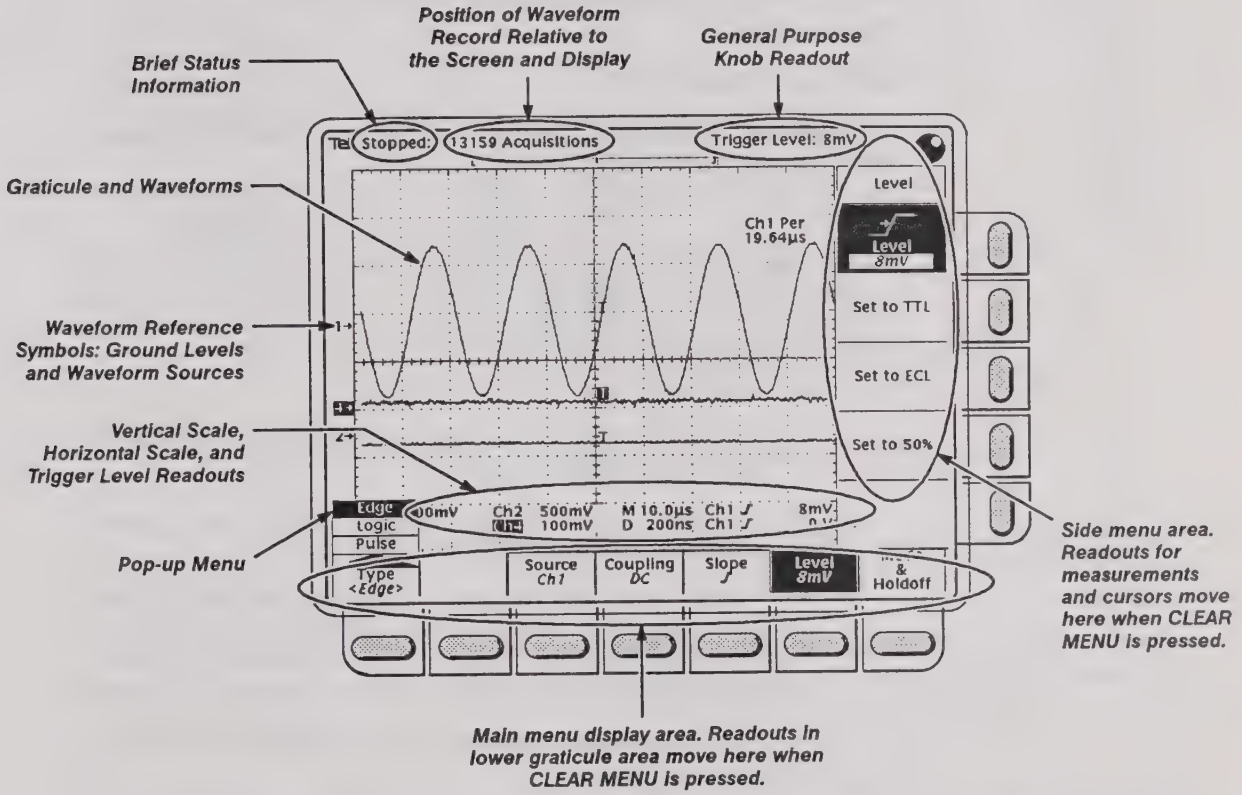


Figure 4-1: Map of Display Functions

- Where instructed to use a front-panel button or knob, or select from a main or side menu, or verify a readout or status message, the name of the button or knob appears in boldface type: "press **SHIFT**; then **ACQUIRE MENU**," "press the main-menu button **Coupling**," or "verify that the status message is ***Pass***.
- In steps and substeps, the lead in statement in italics instructs you what to do, while the instructions that follow tell you how to do it: in the example step below, *"Initialize the instrument"* by doing "Press save/recall **SETUP**. Now, press the main-menu button...."

  Initialize the instrument: Press **SAVE/RECALL SETUP**. Now, press the main-menu button **Recall Factory Setup**; then the side-menu button **OK Confirm Factory Init**.

Self Tests

This procedure uses internal routines to verify that this digitizing oscilloscope functions and was adjusted properly. No test equipment or hookups are required.

Verify Internal Adjustment, Self Compensation, and Diagnostics

Equipment Required: None.

Prerequisites: Power up the digitizing oscilloscope and allow a 20 minute warm-up before doing this procedure.

Procedure:

1. *Verify that internal diagnostics pass:* Do the following substeps to verify passing of internal diagnostics.
   a. *Display the System diagnostics menu:*
      - Press **SHIFT**; then press **UTILITY**.
      - Repeatedly press the main-menu button **System** until **Diag/Err** is highlighted in the pop-up menu.
   b. *Run the System Diagnostics:* Press the main-menu button **Execute**; then press the side-menu button **Run Test**.
   c. *Wait:* The internal diagnostics do an exhaustive verification of proper oscilloscope function. This verification will take about two minutes. While it progresses, a "clock" icon (shown at left) is displayed on-screen. When finished, the resulting status will appear on the screen.
   d. *Confirm no failures are found:* Verify that no failures are found and reported on-screen.
   e. *Confirm the three adjustment sections have passed status:*
      - Press the main menu button **SHIFT**; then press **UTILITY**.
      - Press the main menu button **System** until **Cal** is highlighted in the pop-up menu.
      - Verify that the word ***Pass*** appears in the main menu under the following menu labels: **Voltage Reference**, **Frequency Response**, and **Pulse Trigger**. (See Figure 4-2.)

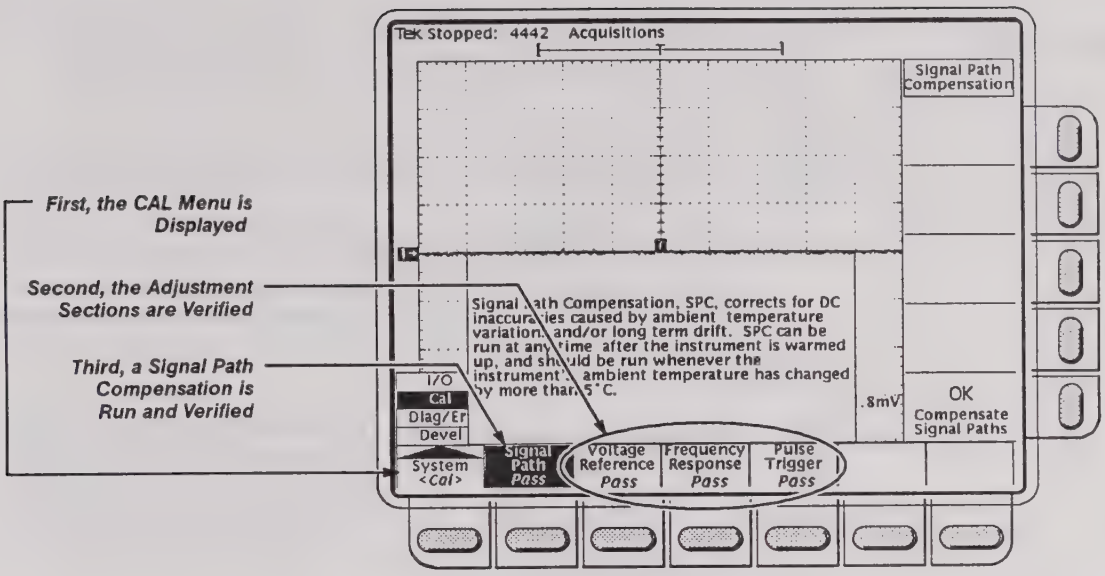

First, the CAL Menu is Displayed
Second, the Adjustment Sections are Verified
Third, a Signal Path Compensation is Run and Verified
Tek Stopped: 4442 Acquisitions
Signal Path Compensation
Signal ath Compensation, SPC, corrects for DC inaccura ies caused by ambient temperature variation and/or long term drift. SPC can be run at any time after the instrument is warmed up, and should be run whenever the instrument's ambient temperature has changed by more than 5°C.
I/O
Cal
Diag/Er
Devel
.8mV
OK
Compensate Signal Paths
System <Cal>
Signal Path Pass
Voltage Reference Pass
Frequency Response Pass
Pulse Trigger Pass

Figure 4-2: Verifying Adjustments and Signal-Path Compensation

f. *Run the signal-path compensation:* Press the main-menu button **Signal Path**; then press the side-menu button **OK Compensate Signal Paths**.

g. *Wait:* Signal-path compensation runs in about one to two minutes. While it progresses, a "clock" icon (shown at left) is displayed on-screen. When compensation completes, the status message will be updated to *Pass* or *Fail* in the main menu (see step h).

h. *Confirm signal-path compensation returns passed status:* Verify the word ***Pass*** appears under **Signal Path** in the main menu. (See Figure 4-2.)

2. *Return to regular service:* Press **CLEAR MENU** to exit the system menus.

Functional Tests

The purpose of these procedures is to confirm that this oscilloscope functions properly. The only equipment required is one of the standard-accessory probes.

These procedures verify functions; that is, they verify that oscilloscope features *operate*. They do *not* verify that they operate within limits.

Therefore, when the instructions in the functional tests that follow call for you to verify that a signal appears on-screen "that is about five divisions in amplitude" or "has a period of about six horizontal divisions," etc., do *NOT* interpret the quantities given as limits. Operation within limits is checked in *Performance Tests*, which begin on page 4-11.

DO NOT make changes to the front-panel settings that are not called out in the procedures. Each verification procedure will require you to set the oscilloscope to certain default settings before verifying functions. If you make changes to these settings, other than those called out in the procedure, you may obtain invalid results. In this case, just redo the procedure from step 1.

When you are instructed to press a menu button, the button may already be selected (its label will be highlighted). If this is the case, it is not necessary to press the button.

Verify All Input Channels

Equipment Required: One P6139 probe.

Prerequisites: None.

Procedure:

1. *Install the test hookup and preset the oscilloscope controls:*

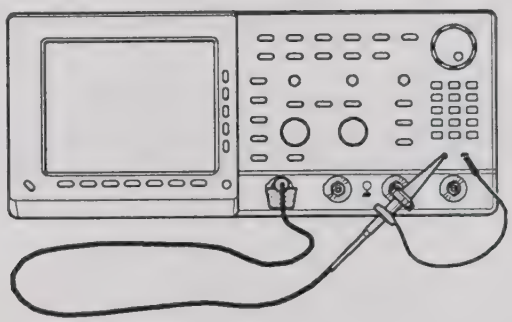


Figure 4-3: Universal Test Hookup for Functional Tests

a. *Hook up the signal source:* Install the probe on **CH 1**. Connect the probe tip to **PROBE COMPENSATION SIGNAL** on the front panel; connect the probe ground to **PROBE COMPENSATION GND**.

b. *Initialize the oscilloscope:*

- Press save/recall **SETUP**.
- Press the main-menu button **Recall Factory Setup**.
- Press the side-menu button **OK Confirm Factory Init**.

2. *Verify that all input channels operate:* Do the following substeps—test CH 1 first, *skipping substep a since CH 1 is already set up for verification from step 1.*

a. *Select an unverified channel:*

- Press **WAVEFORM OFF** to remove from display the channel just verified.
- Press the front-panel button that corresponds to the channel you are to verify.
- Move probe to the channel you selected.

b. *Set up the selected channel:*

- Press **AUTOSET** to obtain a viewable, triggered display in the selected channel.
- Set the horizontal **SCALE** to 200 μs. Press **CLEAR MENU** to remove any menu that may be on the screen.

c. *Verify that the channel is operational:* Confirm that the following statements are true.

- The vertical scale readout for the channel under test shows a setting of 100 mV, and a square-wave probe-compensation signal about five divisions in amplitude is on-screen. (See Figure 4-1 on page 4-3 to locate the readout.)
- The vertical **POSITION** knob moves the signal up and down the screen when rotated.
- Turning the vertical **SCALE** knob counterclockwise decreases the amplitude of the waveform on-screen, turning the knob clockwise increases the amplitude, and returning the knob to 100 mV returns the amplitude to about five divisions.

d. *Verify that the channel acquires in all acquisition modes:* Press **SHIFT**; then press **ACQUIRE MENU**. Use the side menu to select, in turn, each of the five hardware acquire modes and confirm that the following statements are true. Refer to the icons at the left of each statement as you confirm those statements.

- **Sample** mode displays an actively acquiring waveform on-screen. (Note that there is noise present on the peaks of the square wave.)

- **Peak Detect** mode displays an actively acquiring waveform on-screen with the noise present in Sample mode "peak detected."

- **Hi Res** mode displays an actively acquiring waveform on-screen with the noise that was present in Sample mode reduced.

- **Envelope** mode displays an actively acquiring waveform on-screen with the noise displayed.
- **Average** mode displays an actively acquiring waveform on-screen with the noise reduced like in Hi Res mode.

e. *Test all channels:* Repeat substeps a through d until all four input channels are verified.

3. *Remove the test hookup:* Disconnect the probe from the channel input and the probe-compensation terminals.

Verify the Time Base

Equipment Required: One of the P6139 probes.

Prerequisites: None.

Procedure:

1. *Install the test hookup and preset the oscilloscope controls:*

   a. *Hook up the signal source:* Install the probe on **CH 1**. Connect the probe tip to **PROBE COMPENSATION SIGNAL** on the front panel; connect the probe ground to **PROBE COMPENSATION GND**. (See Figure 4-3 on page 4-6.)

   b. *Initialize the oscilloscope:*

   - Press save/recall **SETUP**.
   - Press the main-menu button **Recall Factory Setup**; then press the side-menu button **OK Confirm Factory Init**.

   c. *Modify default settings:*

   - Press **AUTOSET** to obtain a viewable, triggered display.
   - Set the horizontal **SCALE** to 200 µs.
   - Press **CLEAR MENU** to remove the menus from the screen.

2. *Verify that the time base operates:* Confirm the following statements.

   a. One period of the square-wave probe-compensation signal is about five horizontal divisions on-screen for the 200 µs horizontal scale setting (set in step 1c).

   b. Rotating the horizontal **SCALE** knob clockwise expands the waveform on-screen (more horizontal divisions per waveform period), and that counterclockwise rotation contracts it, and that returning the horizontal scale to 200 µs returns the period to about five divisions.

   c. The horizontal **POSITION** knob positions the signal left and right on-screen when rotated.

3. *Remove the test hookup:* Disconnect the probe from the channel input and the probe-compensation terminals.

Verify the Main and Delayed Trigger Systems

Equipment Required: One P6139 probe.

Prerequisites: None.

Procedure:

1. *Install the test hookup and preset the oscilloscope controls:*
   a. *Hook up the signal source:* Install the probe on **CH 1**. Connect the probe tip to **PROBE COMPENSATION SIGNAL** on the front panel; connect the probe ground to **PROBE COMPENSATION GND**. (See Figure 4-3 on page 4-6.)
   b. *Initialize the oscilloscope:*
      - Press save/recall **SETUP**.
      - Press the main-menu button **Recall Factory Setup**.
      - Press the side-menu button **OK Confirm Factory Init**.
   c. *Modify default settings:*
      - Press **AUTOSET** to obtain a viewable, triggered display.
      - Set the horizontal **SCALE** for the **M** (main) time base to 200 µs.
      - Press **TRIGGER MENU**.
      - Press the main-menu button **Mode & Holdoff**.
      - Press the side-menu button **Normal**.
      - Press **CLEAR MENU** to remove the menus from the screen.
2. *Verify that the main trigger system operates:* Confirm that the following statements are true.
   - The trigger level readout for the main trigger system changes with the trigger **LEVEL** knob.
   - The trigger-level knob can trigger and untrigger the square-wave signal as you rotate it. (Leave the signal *un*triggered.)
   - Pressing **SET LEVEL TO 50%** triggers the signal that you just left untriggered. (Leave the signal triggered.)
3. *Verify that the delayed trigger system operates:*
   a. *Select the delayed time base:*
      - Press **HORIZONTAL MENU**.
      - Press the main-menu button **Time Base**.
      - Press the side-menu button **Delayed Triggerable**; then press the side-menu button **Delayed Only**.
      - Set the horizontal **SCALE** for the **D** (delayed) time base to 200 µs.

b. *Select the delayed trigger level menu:*

- Press **SHIFT**; then press **DELAYED TRIG**.
- Press the main-menu button **Level**; then press the side-menu button **Level**.

c. *Confirm that the following statements are true*:

- The trigger-level readout for the delayed trigger system changes with the general purpose knob.
- The general purpose knob can trigger and untrigger the square-wave probe-compensation signal as you rotate it. (Leave the signal *un*triggered.)
- Pressing the side-menu button **Set to 50%** triggers the probe-compensation signal that you just left untriggered. (Leave the signal triggered.)

d. *Verify the delayed trigger counter:*

- Press the main-menu button **Delay by *Time***.
- Use the keypad to enter a delay time of 1 second.
- Verify that the trigger **READY** indicator on the front panel flashes about once every second as the waveform is updated on-screen.

4. *Remove the test hookup:* Disconnect the standard-accessory probe from the channel input and the probe-compensation terminals.

Performance Tests

This subsection contains a collection of procedures for checking that the TDS 520 Digitizing Oscilloscope performs as warranted.

The procedures are arranged in four logical groupings: *Signal Acquisition System Checks, Time Base System Checks, Triggering System Checks*, and *Output Ports Checks*. They check all the characteristics that are designated as checked in Section 1, *Specification,* of the service manual. (The characteristics that are checked appear in **boldface** type under *Warranted Characteristics* in Section 1.)

These procedures *extend* the confidence level provided by the basic procedures described on page 4-1. The basic procedures should be done first, then these procedures performed if desired.

Prerequisites

The tests in this subsection comprise an extensive, valid confirmation of performance and functionality when the following requirements are met:

- The cabinet must be installed on the digitizing oscilloscope.
- You must have performed and passed the procedures under *Self Tests,* found on page 4-4, and those under *Functional Tests,* found on page 4-6.
- A signal-path compensation must have be done within the recommended calibration interval and at a temperature within ±5°C of the present operating temperature. (If at the time you did the prerequisite *Self Tests,* the temperature was within the limits just stated, consider this prerequisite met.)
- The digitizing oscilloscope must have been last adjusted at an ambient temperature between +20°C and +30°C, must have been operating for a warm-up period of at least 20 minutes, and must be operating at an ambient temperature between 0°C and +50°C. (The warm-up requirement is usually met in the course of meeting the first prerequisite listed above.)

Related Information – Read *General Instructions* and *Conventions* that start on page 4-1. Also, if you are not familiar with operating this digitizing oscilloscope, read *General Operating Instructions* in Section 2 of the service manual before doing any of these procedures.

Equipment Required

These procedures utilize external, traceable signal sources to directly check warranted characteristics. The required equipment list follows this introduction.

Table 4-1: Test Equipment

Item Number and Description	Minimum Requirements	Example	Purpose
1 Attenuator, 10X (three required)	Ratio: 10X; impedance 50 Ω; connectors: female BNC input, male BNC output	Tektronix part number 011-0059-02	Signal Attenuation
2 Attenuator, 5X	Ratio: 5X; impedance 50 Ω; connectors: female BNC input, male BNC output	Tektronix part number 011-0060-02	Signal Attenuation
3 Termination, 50 Ω	Impedance 50 Ω; connectors: female BNC input, male BNC output	Tektronix part number 011-0049-01	Signal Termination for Channel Delay Test
4 Cable, Precision Coaxial (two required)	50 Ω, 36 in, male to male BNC connectors	Tektronix part number 012-0482-00	Signal Interconnection
5 Connector, Dual-Banana (two required)	Female BNC to dual banana	Tektronix part number 103-0090-00	Various Accuracy Tests
6 Connector, BNC "T"	Male BNC to dual female BNC	Tektronix part number 103-0030-00	Checking Trigger Sensitivity
7 Coupler, Dual-Input	Female BNC to dual male BNC	Tektronix part number 067-0525-02	Checking Delay Between Channels
8 Generator, DC Calibration	Variable amplitude to ±110 V; accuracy to 0.1%	Data Precision 8200, with 1 kV option installed	Checking DC Offset, Gain, and Measurement Accuracy
9 Generator, Leveled Sine-Wave, Medium-Frequency	200 kHz to 250 MHz; Variable amplitude from 5 mV to 4 V p-p into 50 Ω	TEKTRONIX SG 503 Leveled Sine Wave Generator	Checking Trigger Sensitivity at low frequencies
10 Generator, Leveled Sine-Wave, High-Frequency	250 MHz to 500 MHz; Variable amplitude from 5 mV to 4 V p-p into 50 Ω; 6 MHz reference	TEKTRONIX SG 504 Leveled Sine Wave Generator with a TM 500 Series Power Module with SG 504 Output Head	Checking Analog Bandwidth and Trigger Sensitivity at high frequencies
11 Generator, Time Mark	Variable marker frequency from 10 ms to 10 ns; accuracy within 2 ppm	TEKTRONIX TG 501 Time Mark Generator with a TM 500 Series Power Module	Checking Sample-Rate and Delay-time Accuracy
12 Probe, 10X, included with this instrument	A P6139 probe	Tektronix number P6139	Signal Interconnection

Signal Acquisition System Checks

These procedures check those characteristics that relate to the signal-acquisition system and are listed as checked under *Warranted Characteristics* in Section 1 *Specification.*

Check Accuracy of Offset (Zero Setting)

Equipment Required: None.

Prerequisites: The oscilloscope must meet the prerequisites listed on page 4-11.

1. *Install the test hookup and preset the instrument controls:*
   a. *Initialize the oscilloscope:*
      - Press save/recall **SETUP**.
      - Press the main-menu button **Recall Factory Setup**.
      - Press the side-menu button **OK Confirm Factory Init**.
      - Press **CLEAR MENU** to remove the menus from the screen.
   b. *Modify the default settings:*
      - Set the horizontal **SCALE** to 1 ms.
      - Press **SHIFT**; then **ACQUIRE MENU**.
      - Press the main-menu button **Mode**; then press the side-menu button **Hi Res**.
      - Press **DISPLAY**.
      - Press the main-menu button **Graticule**; then press the side-menu button **Frame**.
      - Press **CURSOR**.
      - Press the main-menu button **Function**; then press the side-menu button **H Bars**.
      - Press **CLEAR MENU**.
2. *Confirm input channels are within limits for offset accuracy at zero offset:* Do the following substeps — test CH 1 first, *skipping substep a since CH 1 is already set up to be checked from step 1.*
   a. *Select an unchecked channel:* Press **WAVEFORM OFF** to remove the channel just confirmed from the display. Then, press the front-panel button that corresponds to the channel you are to confirm.

Table 4-2 DC Offset Accuracy (Zero Setting)

Vertical Scale Setting		Vertical Position and Offset Setting[1]	Offset Accuracy Limits	
CH 1 – CH 4	AUX 1 & AUX 2		CH 1 – CH 4	AUX 1 & AUX 2
1 mV	100 mV	0	±1.6 mV	±150 mV
100 mV	1 V	0	±25 mV	±115 mV
1 V	10 V	0	±250 mV	±1.15 V

[1]Vertical position is set to 0 divisions and vertical offset to 0 V when the oscilloscope is initialized in step 1.

b. *Set the vertical scale:* Set the vertical **SCALE** to one of the settings listed in Table 4-2that is not yet checked. (Start with the first setting listed.)

c. *Display the test signal:* The baseline DC test level was initialized for all channels in step 1 and is displayed as you select each channel and its vertical scale. Be sure *not* to use the vertical **POSITION** knob while checking any channel for accuracy of offset, since varying the position invalidates the check.

d. *Measure the test signal:* Rotate the general purpose knob to superimpose the active cursor over the baseline DC test level. (Ignore the other cursor.)

e. Read the measurement results at the absolute (@:) cursor readout, not the delta (Δ:) readout on screen.

f. *Check against limits:* Do the following subparts in the order listed.

- CHECK that the measurement results are within the limits listed for the current vertical scale setting.
- Repeat substeps b through f until all vertical scale settings settings listed in are checked for the channel under test.

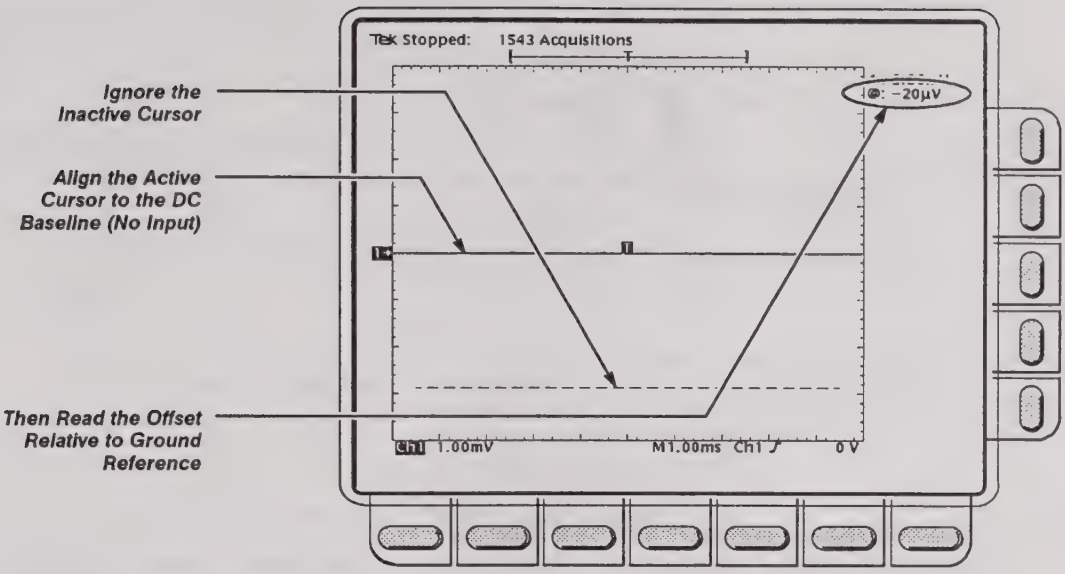

Ignore the Inactive Cursor
Align the Active Cursor to the DC Baseline (No Input)
Then Read the Offset Relative to Ground Reference
Tek Stopped: 1543 Acquisitions
@: -20µV
Ch1 1.00mV
M1.00ms Ch1 ƒ 0 V

Figure 4-4: Measurement of DC Offset Accuracy at Zero Setting

g. *Test all channels:* Repeat substeps a through f for all input channels.

3. *Disconnect the hookup:* No hookup was required.

Check DC Gain and Voltage Measurement Accuracy

WARNING

Performance of this procedure requires input voltages up to 180 VDC. Be sure to set the DC calibration generator to 0 volts before connecting, disconnecting, and/or moving the test hookup during the performance of this procedure.

Equipment Required: Two dual-banana connectors (Item 5), one BNC T connector (Item 6), one DC calibration generator (Item 8), and two precision coaxial cables (Item 4).

Prerequisites: The oscilloscope must meet the prerequisites listed on page 4-11.

Procedure:

1. *Install the test hookup and preset the instrument controls:*

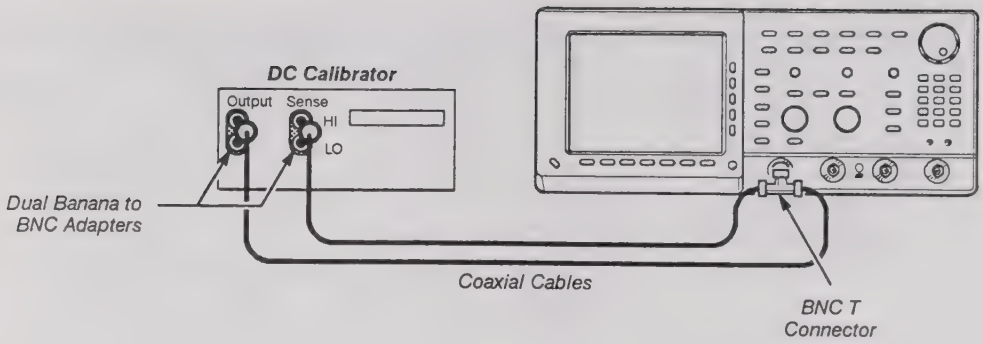


Figure 4-5: Initial Test Hookup

a. *Hook up the test-signal source:*

- Set the output of a DC calibration generator to 0 volts.
- Connect the output of a DC calibration generator through a dual-banana connector followed by a 50 Ω precision coaxial cable to one side of a BNC T connector.
- Connect the Sense output of the generator through a second dual-banana connector followed by a 50 Ω precision coaxial cable to other side of the BNC T connector. Now connect the BNC T connector to **CH 1**.

b. *Initialize the oscilloscope:*

- Press save/recall **SETUP**.
- Press the main-menu button **Recall Factory Setup**.
- Press the side-menu button **OK Confirm Factory Init**.

c. *Modify the default settings:*

- Press **SHIFT**; then **ACQUIRE MENU**.
- Press the main-menu button **Mode**; then press the side-menu button **Average 16**.
- Press **CURSOR**.
- Press the main-menu button **Function**; then press the side-menu button **H Bars**.
- Press **DISPLAY**.
- Press the main-menu button **Graticule**; then press the side-menu button **Frame**.

2. *Confirm input channels are within limits for DC delta voltage accuracy:* Do the following substeps — test CH 1 first, *skipping substep a since CH 1 is already selected from step 1.*

a. *Select an unchecked channel:*

- *Set the generator output to 0 V.*
- Press **WAVEFORM OFF** to remove the channel just confirmed from the display.
- Press the front-panel button that corresponds to the next channel you are to confirm.
- Move the test hook up to the channel you select.

b. *Display the test signal:*

- Press **VERTICAL MENU**. Press the main-menu button **Position**.
- Use the keypad to set vertical position to −2.5 divisions (press **−2.5**, then **ENTER**, on the keypad).

c. *Measure the test signal:*

- Press **CURSOR**. Use the general purpose knob to precisely align the active cursor to the DC baseline level on screen.
- Set the generator output to 500 mV.
- Press **TOGGLE**. Use the general purpose knob to precisely align the alternate cursor to the 500 mV DC test level on screen.
- Press **CLEAR MENU**. Read the measurement results from the delta (Δ:) readout, not the absolute (@:) readout. See Figure 4-6 on page 4-17.

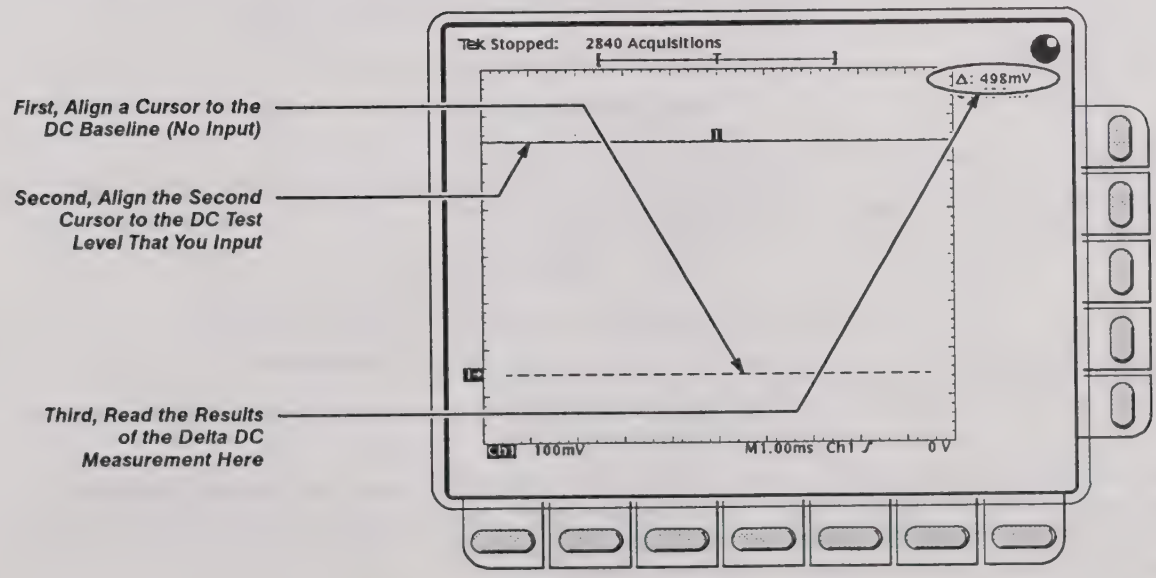

First, Align a Cursor to the DC Baseline (No Input)
Second, Align the Second Cursor to the DC Test Level That You Input
Third, Read the Results of the Delta DC Measurement Here
Tek Stopped: 2840 Acquisitions
Δ: 498mV
Ch1 100mV
M1.00ms Ch1 ƒ 0 V

Figure 4-6: Measurement of the DC Accuracy for Delta Measurements

d. *Check against limits:* CHECK that the Δ: readout on screen is within 485 mV to 515 mV.

e. *Test all channels:* Repeat substeps a through d for all four channels.

3. *Reestablish the initial test hookup setup:*

   a. *Hook up the test-signal source:*

      - Set the output of a DC calibration generator to 0 volts.
      - Move the BNC T connector back to **CH 1**.

   b. *Initialize the oscilloscope:*

      - Press save/recall **SETUP**.
      - Press the main-menu button **Recall Factory Setup**.
      - Press the side-menu button **OK Confirm Factory Init**.

   c. *Modify the default settings:*

      - Press **SHIFT**; then **ACQUIRE MENU**.
      - Press the main-menu button **Mode**; then press the side-menu button **Hi Res**.
      - Press **DISPLAY**.
      - Press the main-menu button **Graticule**; then press the side-menu button **Frame**.

4. *Confirm input channels are within limits for DC accuracy at maximum offset and position:* Do the following substeps — test CH 1 first, *skipping substep a since CH 1 is already selected from step 3.*

   a. *Select an unchecked channel:*

      - Press **WAVEFORM OFF** to remove the channel just confirmed from the display.
      - Press the front-panel button that corresponds to the channel you are to confirm.
      - *Set the generator output to 0 V.*
      - Move the test hookup to the channel you select.

   b. *Turn on the measurement Mean for the channel:*

      - Press **MEASURE**, then press the main-menu button **Select Measurement for CHx**.
      - Press the side menu button **more** until the menu label **Mean** appears in the side menu (its icon is shown at the left). Press the side-menu button **Mean**.

      - Press **CLEAR MENU**.

   c. *Set its vertical scale:* Set the vertical **SCALE** to one of the settings listed in the table matching the channel under test that is not yet checked. (Start with the first setting listed.)

Table 4-3 DC Accuracy: CH 1–CH 2

Scale Setting	Position Setting (Divs)	Offset Setting	Generator Setting	Accuracy Limits
5 mV	–5	+1 V	+1.040 V	+1.0355 V to +1.0445 V
	+5	–1 V	–1.040 V	–1.0355 V to –1.0445 V
200 mV	–5	+10 V	+11.6 V	+11.525 V to +11.675 V
	+5	–10 V	–11.6 V	–11.525 V to –11.675 V
1 V	–5	+100 V	+108 V	+107.450 V to +108.550 V
	+5	–100 V	–108 V	–107.450 V to –108.550 V

Table 4-4 DC Accuracy: AUX 1–AUX 2

Scale Setting	Position Setting (Divs)	Offset Setting	Generator Setting	Accuracy Limits
100 mV	–5	+0.5 V	+1.3 V	+1.271 V to +1.329 V
	+5	–0.5 V	–1.3 V	–1.271 V to –1.329 V
1 V	–5	+5 V	+13 V	+12.710 V to +13.290 V
	+5	–5 V	–13 V	–12.710 V to –13.290 V
10 V	–5	+50 V	+130 V	+127.10 V to +132.90 V
	+5	–50 V	–130 V	–127.10 V to –132.90 V

d. *Display the test signal:*

- Press **VERTICAL MENU**. Press the main-menu button **Position**.
- Use the keypad to set vertical position to –5 divisions (press **–5**, then **ENTER**, on the keypad.) The baseline level will move off screen.
- Press the main-menu button **Offset**.
- Use the keypad to set vertical offset to the positive-polarity setting listed in the table for the current vertical scale setting. The baseline level will remain off screen.
- Set the generator to the level and polarity indicated in the table for the vertical scale, position, and offset settings you have made. The DC test level should appear on screen. (If it doesn't return, the DC accuracy check is failed for the current vertical scale setting of the current channel.

e. *Measure the test signal:* Press **CLEAR MENU**. Read the measurement results at the **Mean** measurement readout. See Figure 4-7.

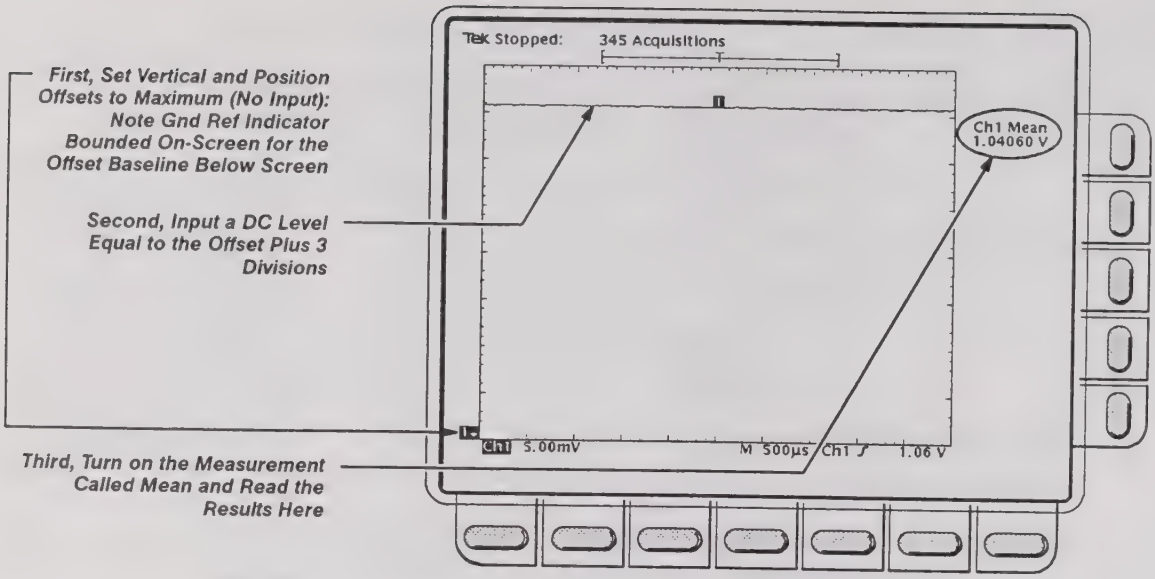

First, Set Vertical and Position Offsets to Maximum (No Input): Note Gnd Ref Indicator Bounded On-Screen for the Offset Baseline Below Screen
Second, Input a DC Level Equal to the Offset Plus 3 Divisions
Third, Turn on the Measurement Called Mean and Read the Results Here
Tek Stopped: 345 Acquisitions
Ch1 Mean 1.04060 V
Ch1 5.00mV
M 500µs Ch1 1.06 V

Figure 4-7: Measurement of DC Accuracy at Maximum Offset and Position

f. *Check against limits:*

- CHECK that the readout for the measurement **Mean** readout on screen is within the limits listed for the current vertical scale and position/offset/generator settings.
- Repeat step d, reversing the polarity of the position, offset, and generator settings as is listed in the table.
- CHECK that the **Mean** measurement readout on screen is within the limits listed for the current vertical scale setting and position/offset/generator settings.
- Repeat substeps c through f until all vertical scale settings settings listed in both tables are checked for the channel under test. (Use the table that matches the input under test — CH or AUX.)

g. *Test all channels:* Repeat substeps a through f for all four channels.

5. *Disconnect the hookup:*

a. *Set the generator output to 0 V.*

b. Then disconnect the cable from the generator output at the input connector of the channel last tested.

Check Analog Bandwidth

Equipment Required: One high-frequency leveled sine-wave generator and its leveling head (item 10), plus three 10X attenuators (item 1).

Prerequisites: *See page 4-11*

Procedure:

1. *Install the test hookup and preset the instrument controls:*
   a. *Initialize the oscilloscope:*
      - Press save/recall **SETUP**.
      - Press the main-menu button **Recall Factory Setup**.
      - Press the side-menu button **OK Confirm Factory Init**.
   b. *Modify the default settings:*
      - Set the horizontal **SCALE** to 50 ns.
      - Press **SHIFT**; then **ACQUIRE MENU**.
      - Press the main-menu button **Mode**; then press the side-menu button **Average 16**.

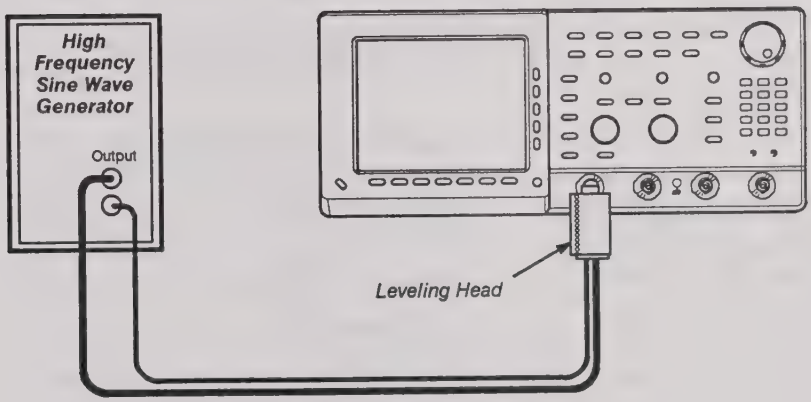


Figure 4-8: Initial Test Hookup

   c. *Hook up the test-signal source:* Connect, through its leveling head, the sine-wave output of a high-frequency leveled sine-wave generator to **CH 1**. Set the output of the generator to a reference frequency of 6 MHz.

2. *Confirm the input channels are within limits for analog bandwidth:* Do the following substeps — test CH 1 first, *skipping substeps a and b since CH 1 is already set up for testing from step 1.*

   a. *Select an unchecked channel:*

      - Press **WAVEFORM OFF** to remove the channel just confirmed from display.
      - Press the front-panel button that corresponds to the channel you are to confirm.
      - Move the leveling head to the channel you select.

   b. *Match the trigger source to the channel selected:*

      - Press **TRIGGER MENU**.
      - Press the main-menu button **Source**.
      - Press the side-menu button that corresponds to the channel selected.

   c. *Set its input impedance:*

      - Press **VERTICAL MENU**; then press the main-menu button **Coupling**.
      - Press the side-menu button Ω to toggle it to the 50 Ω setting.

   d. *Set the vertical scale:* Set the vertical **SCALE** to one of the settings listed in Table 4-5 not yet checked. (Start with the 100 mV setting.)

Table 4-5: Analog Bandwidth

Vertical Scale[1]	Attenuators (10X)	Reference Amplitude (at 6 MHz)	Horizontal Scale	Test Frequency	Limits
100 mV	none	600 mV (6 divisions)	1 ns	500 MHz	≥424 mV
1 V	none	5 V (5 divisions)	1 ns	500 MHz	≥3.835 mV
500 mV	none	3 V (6 divisions)	1 ns	500 MHz	≥2.121 mV
200 mV	none	1.2 V (6 divisions)	1 ns	500 MHz	≥840 mV
50 mV	1	300 mV (6 divisions)	1 ns	500 MHz	≥212.1 mV
20 mV	1	120 mV (6 divisions)	1 ns	500 MHz	≥84 mV
10 mV	2	60 mV (6 divisions)	1 ns	500 MHz	≥42.4 mV
5 mV	2	30 mV (6 divisions)	1 ns	500 MHz	≥21.2 mV
2 mV	2	12 mV (6 divisions)	2 ns	350 MHz	≥8.4 mV
1 mV	3	6 mV (6 divisions)	2 ns	250 MHz	≥4.2 mV

[1]**Only the 100 mV, 1 V, and 10 V vertical scale settings are available for the AUX 1 and AUX 2 input channels. Ignore all other settings listed when checking those channels.**

e. *Display the test signal:* Do the following subparts to first display the reference signal and then the test signal.

- Press **MEASURE**; then press the main-menu button **Select Measurement for CHx**.
- Now press the side menu button **more** until the menu label **Pk-Pk** appears in the side menu (its icon is shown at the left). Press the side-menu button **Pk-Pk**.
- Press **CLEAR MENU**.
- Set the generator output so the CHx Pk-Pk readout equals the reference amplitude in Table 4-5 that corresponds to the vertical scale set in substep d.
- Press the front-panel button **SET LEVEL TO 50%** as necessary to trigger a stable display.

f. *Measure the test signal:*

- Increase the frequency of the generator output to the test frequency in Table 4-5 that corresponds to the vertical scale set in substep d.
- Set the horizontal **SCALE** to 1 ns. Press **SET LEVEL TO 50%** as necessary.
- Read the results at the CHx Pk-Pk readout, which will automatically measure the amplitude of the test signal.

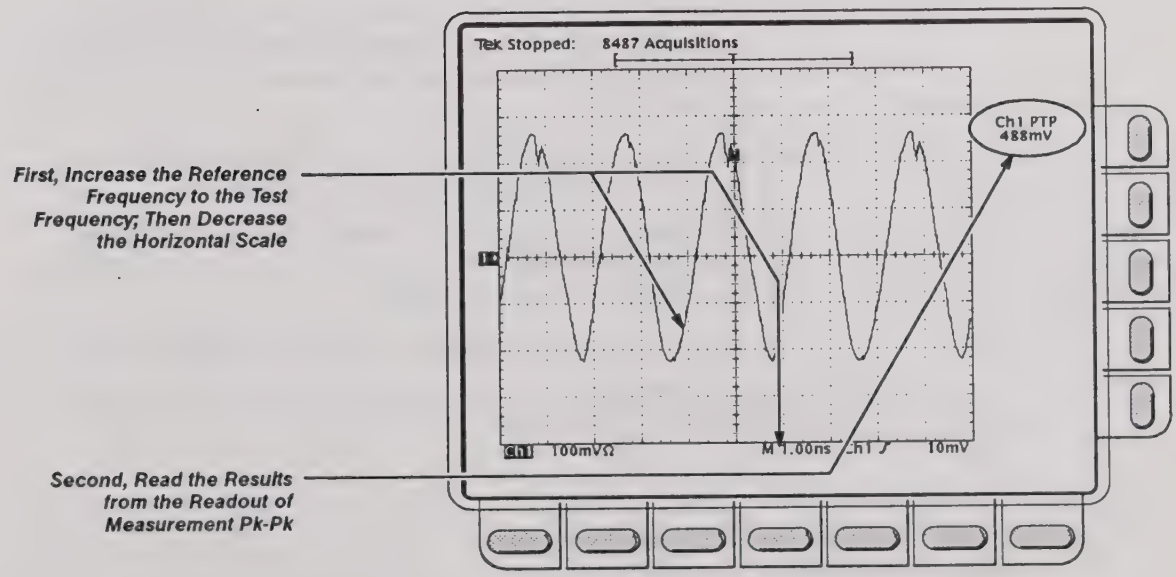

First, Increase the Reference Frequency to the Test Frequency; Then Decrease the Horizontal Scale
Second, Read the Results from the Readout of Measurement Pk-Pk
Tek Stopped: 8487 Acquisitions
Ch1 PTP 488mV
Ch1 100mVΩ
M 1.00ns Ch1 ƒ 10mV

Figure 4-9: Measurement of Analog Bandwidth

g. *Check against limits:*

- CHECK that the **Pk-Pk** readout on screen is within the limits listed in Table 4-5 for the current vertical scale setting.
- When finished checking, set the horizontal **SCALE** back to the 50 ns setting.

Checking each channel's bandwidth at all vertical scale settings is time consuming and unnecessary. You may skip checking the remaining vertical scale settings in Table 4-5 (that is, skip the following substep, h) if this digitizing oscilloscope has performed as follows:

- Passed the 100 mV vertical scale setting just checked in this procedure.
- Passed the *Verify Internal Adjustment, Self Compensation, and Diagnostics* procedure found under *Self Tests,* on page 4-4.

NOTE

Passing the signal path compensation confirms the signal path for all vertical scale settings for all channels. Passing the internal diagnostics ensures that the factory-set adjustment constants that control the bandwidth for each vertical scale setting have not changed.

h. *Check remaining vertical scale settings against limits (optional):*

- If desired, finish checking the remaining vertical scale settings for the channel under test by repeating substeps d through g for each of the remaining scale settings settings listed in Table 4-5 for the channel under test.
- When doing substep e, skip the subparts that turn on the CHx Pk-Pk measurement until you check a new channel.
- Install/remove 10X attenuators between the generator leveling head and the channel input as is needed to obtain the six division reference signals listed in the table.

i. *Test all channels:* Repeat substeps a through g for all four channels.

3. *Disconnect the hookup:* Disconnect the test hook up from the input connector of the channel last tested.

Check Delay Between Channels

Equipment Required: One medium-frequency leveled sine-wave generator (Item 9), one precision coaxial cable (Item 4), one 50 Ω terminator (item 3), and a dual-input-coupler (Item 7).

Prerequisites: *See page 4-11*

Procedure:

DO NOT use the vertical position knob to reposition any channel while doing this check. To do so invalidates the test.

1. *Install the test hookup and preset the instrument controls:*
   a. *Initialize the front panel;*
      - Press save/recall **SETUP**.
      - Press the main-menu button **Recall Factory Setup**.
      - Press the side-menu button **OK Confirm Factory Init**.
   b. *Modify the initialized front-panel control settings:*
      - Do *not* adjust the vertical position of any channel during this procedure.
      - Set the horizontal **SCALE** to 500 ps.
      - Press **SHIFT**; then press **ACQUIRE MENU**.
      - Press the main-menu button **Mode**, and then press the side-menu button **Average 16**.

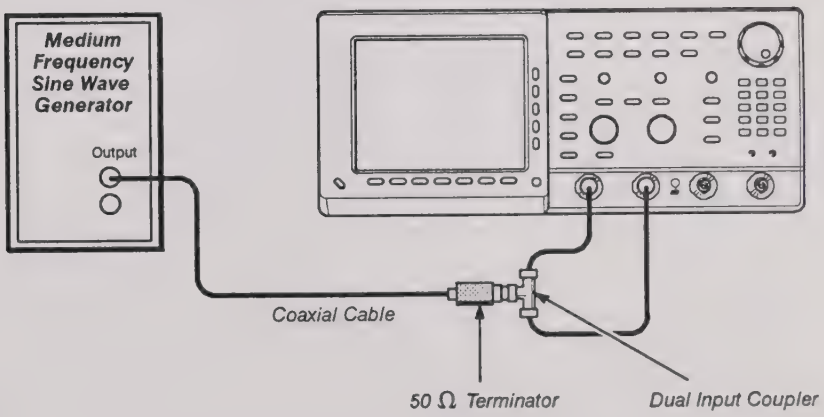


Figure 4-10: Initial Test Hookup

c. *Hook up the test-signal source:*

- Connect, through a 50 Ω precision coaxial cable, followed by a 50 Ω termination, the sine wave output of a medium-frequency sine wave generator to a dual-input coupler.
- Connect the coupler to both **CH 1** and **CH 2**.

2. *Confirm CH 1 through CH 2 are within limits for channel delay:*

a. *Set up the generator:* Set the generator frequency to 250 MHz and the amplitude for about five divisions in CH 1.

b. *Display all test signals:* Press **CH 2**.

Hint: as you are adjusting the generator amplitude, push **SET LEVEL TO 50%** frequently to speed up the updating of the waveform amplitude on screen.

c. *Measure the test signal:*

- Locate the point on the rising edge of the left-most waveform where it crosses the center horizontal graticule line. This is the *time reference point* for this waveform. Note the corresponding *time reference point* for right-most waveform. See Figure 4-11.
- Press **CURSOR**; then press the side-menu button **V Bars**.
- Press **CLEAR MENU**.
- Rotate the General Purpose knob to align one cursor to the *time reference point* of the left-most waveform edge and the other cursor to the *time reference point* of the right-most waveform edge. (Press **TOGGLE** to switch between the two cursors.) See Figure 4-11.

- Read the measurement results at the Δ: cursor readout, not the @: readout on screen.

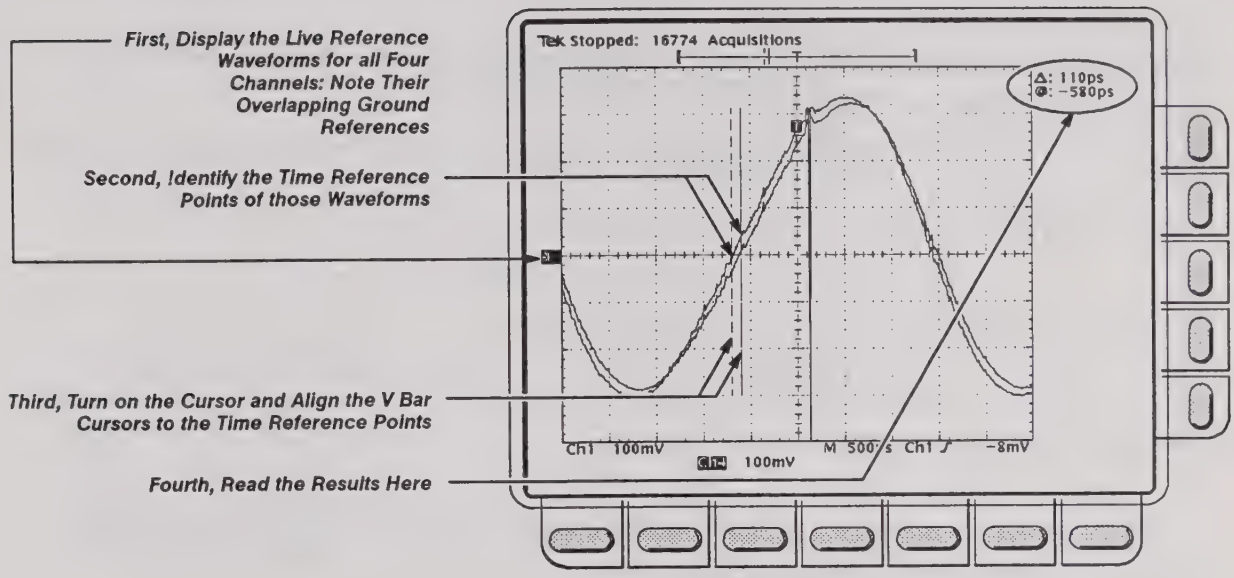

First, Display the Live Reference Waveforms for all Four Channels: Note Their Overlapping Ground References
Second, Identify the Time Reference Points of those Waveforms
Third, Turn on the Cursor and Align the V Bar Cursors to the Time Reference Points
Fourth, Read the Results Here
Tek Stopped: 16774 Acquisitions
Δ: 110ps
@: -580ps
Ch1 100mV
Ch1 100mV
M 500
Ch1
-8mV

Figure 4-11: Measurement of Channel Delay

f. *Check against limits:* CHECK that the cursor readout on screen is ≤250 ps.

4. *Disconnect the hookup:* Disconnect the cable from the generator output at the input connectors of the channels.

Time Base System Checks

These procedures check those characteristics that relate to the Main and Delayed time base system and are listed as checked under *Warranted Characteristics* in Section 1, *Specification.*

Check Accuracy for Long-Term Sample Rate, Delay Time, and Delta Time Measurements

Equipment Required: One time-marker generator (Item 11) and one precision coaxial cable (Item 4).

Prerequisites: *See page 4-11.*

Procedure:

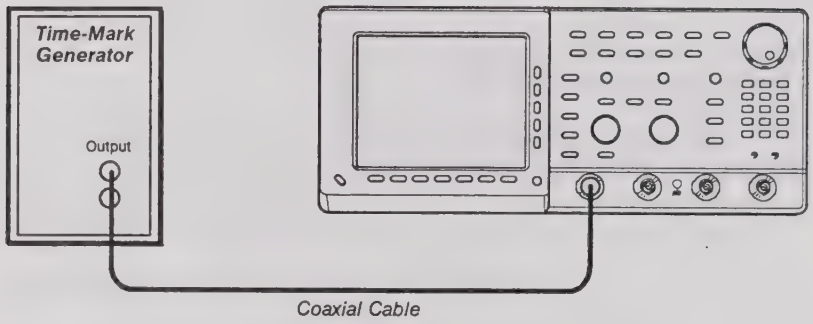


Figure 4-12: Initial Test Hookup

1. *Install the test hookup and preset the instrument controls:*
   a. *Hook up the test-signal source*: Connect, through a 50 Ω precision coaxial cable, the time-mark output of a time-marker generator to **CH 1**. Set the output of the generator for 10 ms markers.
   b. *Initialize the oscilloscope:*
      - Press save/recall **SETUP**.
      - Press the main-menu button **Recall Factory Setup**.
      - Press the side-menu button **OK Confirm Factory Init**.
   c. *Modify the initialized front-panel control settings:*
      - Set the vertical **SCALE** to 500 mV.
      - Press **VERTICAL MENU**; then press the main-menu button **Coupling**. Press the side-menu button Ω to **50 Ω**.
      - Press **SET LEVEL TO 50%**.
      - Use the vertical **POSITION** knob to center the test signal on screen.
      - Set the horizontal **SCALE** of the Main time base to 1 ms.

- Press **TRIGGER MENU**; then press the main-menu button **Mode & Holdoff**. Now press the side-menu button **Normal**.
- Press **SET LEVEL TO 50%**.
- Press horizontal **MENU**. Press the main-menu button **Record Length**; then press the side-menu button **1000 points in 20 divs**.
- Press the main-menu button **Trigger Position**. Press the side-menu button **Pretrigger**; then set pretrigger to 20%: press **20**, then **ENTER**, on the keypad.

2. *Confirm Main and Delayed time bases are within limits for accuracies:*

   a. *Display the test signal:*

   - Adjust the horizontal **POSITION** so the trigger **T** is aligned to the center vertical graticule line.
   - Press the main-menu button **Time Base**
   - Press the side-menu buttons **Delayed Only** and **Delayed Runs After Main**.

   b. *Measure the test signal*:

   - Set the horizontal **SCALE** of the **D** (delayed) time base to 50 ns.
   - Use the keypad to set delayed time to 10 ms. (Press **10**, then **SHIFT**, then **m** followed by **ENTER**.)

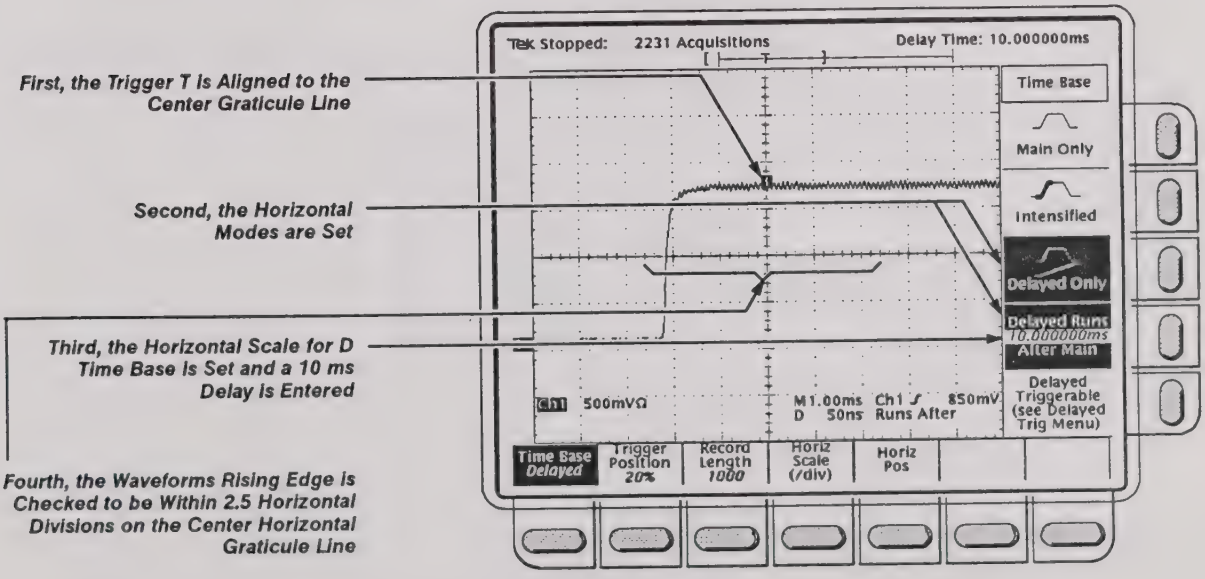

First, the Trigger T is Aligned to the Center Graticule Line
Second, the Horizontal Modes are Set
Third, the Horizontal Scale for D Time Base is Set and a 10 ms Delay is Entered
Fourth, the Waveforms Rising Edge is Checked to be Within 2.5 Horizontal Divisions on the Center Horizontal Graticule Line
Tek Stopped: 2231 Acquisitions
Delay Time: 10.000000ms
Time Base
Main Only
Intensified
Delayed Only
Delayed Runs After Main
10.000000ms
Delayed Triggerable (see Delayed Trig Menu)
Ch1 500mVΩ
M1.00ms Ch1 ƒ 850mV
D 50ns Runs After
Time Base Delayed
Trigger Position 20%
Record Length 1000
Horiz Scale (/div)
Horiz Pos

Figure 4-13: Measurement of Accuracy — Long-Term and Delay-Time

c. *Check long-term sample rate and delay time accuracies against limits:* CHECK that the rising edge of the marker crosses the center horizontal graticule line at a point within ±2.5 divisions of center graticule.

d. *Check delta-time accuracy against limits:*

- Press the side-menu button **Main Only**. Set horizontal **SCALE** to 2 ns.
- Set the output of the generator for 20 ns markers.
- Press **SET LEVEL TO 50%**
- Press **SHIFT**; then **ACQUIRE MENU**. Now press the main-menu button **Mode**; then press the side-menu button **Average**.
- Enter **8**, for eight averages, on the keypad.
- Press **MEASURE**.
- Press the main-menu button **High-Low Setup**; then press the side-menu button **Min-Max**.
- Press the main-menu button **Select Measurement for Ch1**.
- Press the side-menu button **–more–**, until **PERIOD** appears in the side menu. Press **PERIOD**.
- Press **CLEAR MENU**.
- CHECK that the readout for **CH 1 Per** is within 19.760 ns to 20.240 ns.

3. *Disconnect the hookup:* Disconnect the cable from the generator output at the input connector of **CH 1**.

Trigger System Checks

These procedures check those characteristics that relate to the Main and Delayed trigger systems and are listed as checked under *Warranted Characteristics* in Section 1, *Specification.*

Check Accuracy (Time) for Pulse-Glitch or Pulse-Width Triggering

Equipment Required: One medium-frequency leveled sine-wave generator (Item 9), one 10X attenuator (Item 1), and one precision coaxial cable (Item 4).

Prerequisites: *See page 4-11.*

Procedure:

1. *Install the test hookup and preset the instrument controls:*
   a. *Initialize the instrument.*
      - Press save/recall **SETUP**.
      - Press the main-menu button **Recall Factory Setup**.
      - Press the side-menu button **OK Confirm Factory Init**.
   b. *Modify the default setup:*
      - Press vertical **MENU**.
      - Press the main-menu button **Coupling**; then press the side-menu button Ω to select 50 Ω coupling.
      - Set the horizontal **SCALE** to 10 ns.

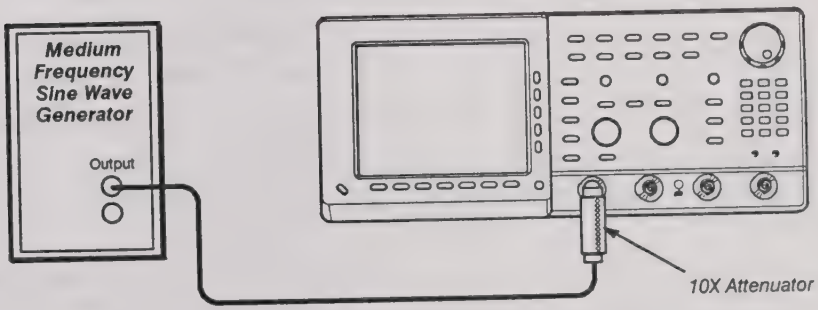


Figure 4-14: Initial Test Hookup

   c. *Hook up the test-signal source*: Connect, through a 50 Ω precision coaxial cable, followed by a 10X attenuator, the output of a medium-frequency leveled sine-wave generator (Item 9) to CH 1.

2. *Confirm the trigger system is within time-accuracy limits for pulse-glitch or pulse-width triggering (Horizontal Scale ≤1 μs):*

   a. *Display the test signal:* Set the output of the sine wave generator for a 100 MHz, five-division sine wave on screen. Press **SET LEVEL TO 50%**.

   b. *Set the trigger mode:* Press **TRIGGER MENU**. Now press the main-menu button **Mode & Holdoff**; then the side-menu button **Normal**.

   c. *Set upper and lower limits that ensures triggering:*

      - Press the main-menu button **Type**; then repeatedly press the same button until **Pulse** is highlighted in the menu that pops up.
      - Press the main-menu button **Class**; then repeatedly press the same button until **Width** is highlighted in the menu that pops up.
      - Press the main-menu button **Trig When**; then press the side-menu button **Within Limits.**
      - Press the side-menu button **Upper Limit**. Use the keyboard to set the upper limit to 10 ns: press **10**; then **SHIFT**; then **n**; then **ENTER**.
      - Press the side-menu button **Lower Limit**. Use the keypad to set the lower limit to 2 ns.

   d. *Check against limits:*

      - Press **SET LEVEL TO 50%**.
      - While doing the following subparts, monitor the display (it will stop acquiring) and the front-panel light **TRIG** (it will extinguish) to determine when triggering is lost.
      - Use the general purpose knob to *increase* the **Lower Limit** readout until triggering is lost.
      - CHECK that the **Lower Limit** readout is within 2.5 ns to 7.5 ns, inclusive.
      - Use the keypad to return the **Lower Limit** to 2 ns and reestablish triggering.
      - Press the side-menu button **Upper Limit**; then use the general purpose knob to slowly *decrease* the the **Upper Limit** readout until triggering is lost.
      - CHECK that the **Upper Limit** readout is within 2.5 ns to 7.5 ns, inclusive.

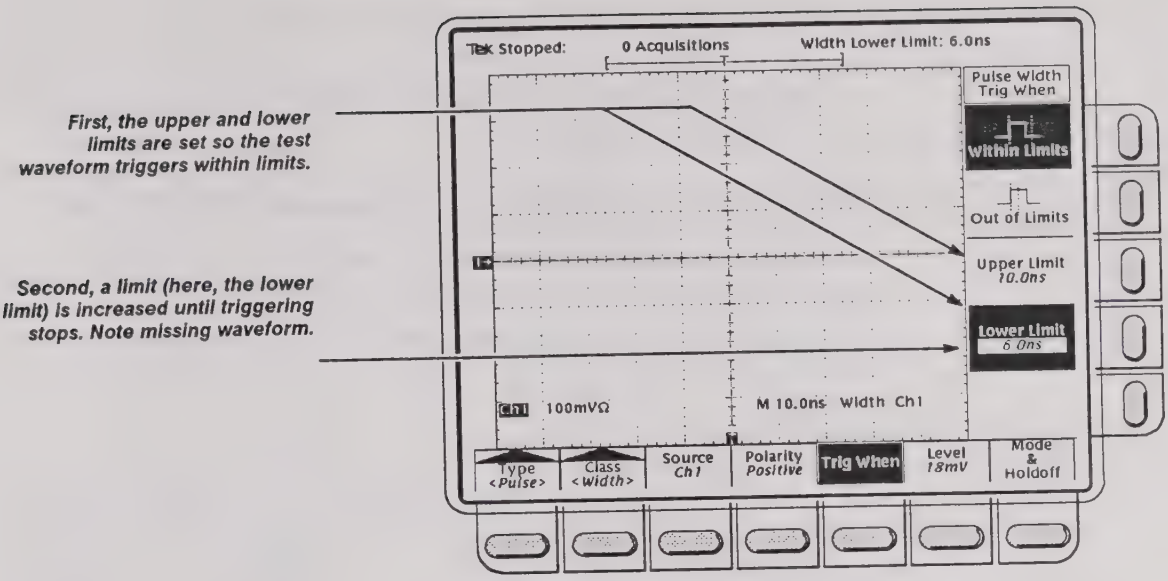


Figure 4-15: Measurement of Time Accuracy for Pulse and Glitch Triggering

3. *Confirm the trigger system is within time-accuracy limits for pulse-glitch or pulse-width triggering (horizontal scale >1 µs):*

   a. *Set upper and lower limits that ensures triggering at 250 kHz:*

      - Press the side-menu button **Upper Limit**. Use the keyboard to set the upper limit to 4 µs.
      - Press the side-menu button **Lower Limit**. Use the keypad to set the lower limit to 500 ns.

   b. *Display the test signal:*

      - Set the horizontal **SCALE** to 5 µs.
      - Set the output of the sine-wave generator for a 250 kHz, five-division sine wave on screen. Set the vertical **SCALE** to 20 mV (the waveform will overdrive the display).
      - Press **SET LEVEL TO 50%**.

   c. *Check against limits:* Do the following subparts in the order listed.

      - Use the general purpose knob to *increase* **Lower Limit** readout until triggering is lost.
      - CHECK that the **Lower Limit** readout is within 1 µs to 3 µs, inclusive.
      - Use the keypad to return the **Lower Limit** to 500 ns and reestablish triggering.
      - Press the side-menu button **Upper Limit**; then use the general purpose knob to slowly *decrease* the the **Upper Limit** readout until triggering is lost.

- CHECK that the **Upper Limit** readout is within 1 µs to 3 µs, inclusive.

4. *Disconnect the hookup:* Disconnect the cable from the generator output at the input connector of **CH 1**.

Check Accuracy, Trigger-level or Threshold, DC Coupled

Equipment Required: One DC calibration generator (Item 8), one BNC T connector (Item 6), and two precision coaxial cables (Item 4).

Prerequisites: The oscilloscope must meet the prerequisites listed on page 4-11.

Procedure:

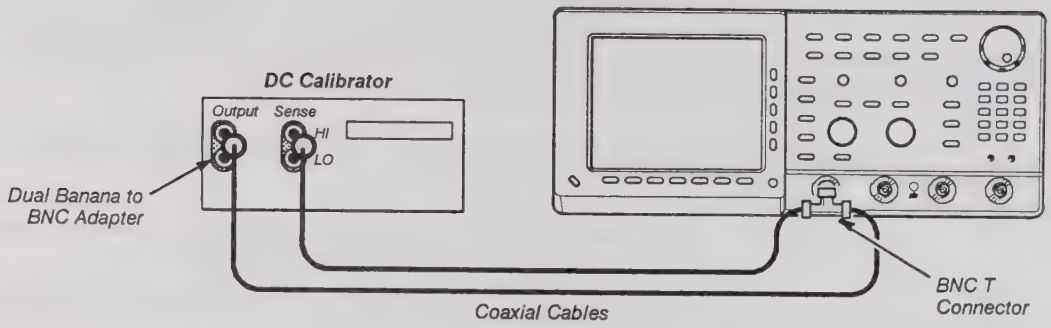


Figure 4-16: Initial Test Hookup

1. *Install the test hookup and preset the instrument controls:*

   a. *Hook up the test-signal source*:

   - Set the output of a DC calibration generator to 0 volts.
   - Connect the output of a DC calibration generator through a dual-banana connector followed by a 50 Ω precision coaxial cable to one side of a BNC T connector.
   - Connect the Sense output of the generator, through a second dual-banana connector followed by a 50 Ω precision coaxial cable, to other side of the BNC T connector. Now connect the BNC T connector to **CH 1**.

   b. *Initialize the oscilloscope:*

   - Press save/recall **Setup**.
   - Press the main-menu button **Recall Factory Setup**.
   - Press the side-menu button **OK Confirm Factory Init**.

2. *Confirm Main trigger system is within limits for Trigger-level/Threshold accuracy:*

   a. *Display the test signal:*

      - Press **VERTICAL MENU**. Press the main-menu button **Position**.
      - Use the keypad to set vertical position to –3 divisions (press **–3**, then **ENTER**, on the keypad.) The baseline level will move off-screen.
      - Press the main-menu button **Offset**.
      - Use the keypad to set vertical offset to + 10 volts. The baseline level will remain off-screen.
      - Set the standard output of a DC calibration generator to + 10 volts. The DC test level will appear on screen.

   b. *Measure the test signal:*

      - Press **SET LEVEL TO 50%**.
      - Press **TRIGGER MENU**.
      - Read the measurement results from the readout below the label **Level** in the menu; not the trigger readout in the graticule area.

   c. *Check against limits:*

      - CHECK that the **Level** readout in the main menu is within 9.940 V to 10.060 V, inclusive.
      - Press **TRIGGER MENU**. Press the main-menu button **Slope**; then press the side-menu button for negative slope. (See icon at left.) Repeat substep b.
      - CHECK that the **Level** readout in the main menu is within 9.940 V to 10.060 V, inclusive.

3. *Confirm Delayed trigger system is within limits for Trigger-level/Threshold accuracy:*

   a. *Select the Delayed time base:*

      - Press **HORIZONTAL MENU**.
      - Press the main-menu button **Time Base**.
      - Press the side-menu buttons **Delayed Only** and **Delayed Triggerable**.
      - Set **D** (delayed) horizontal **SCALE** to 500 µs.

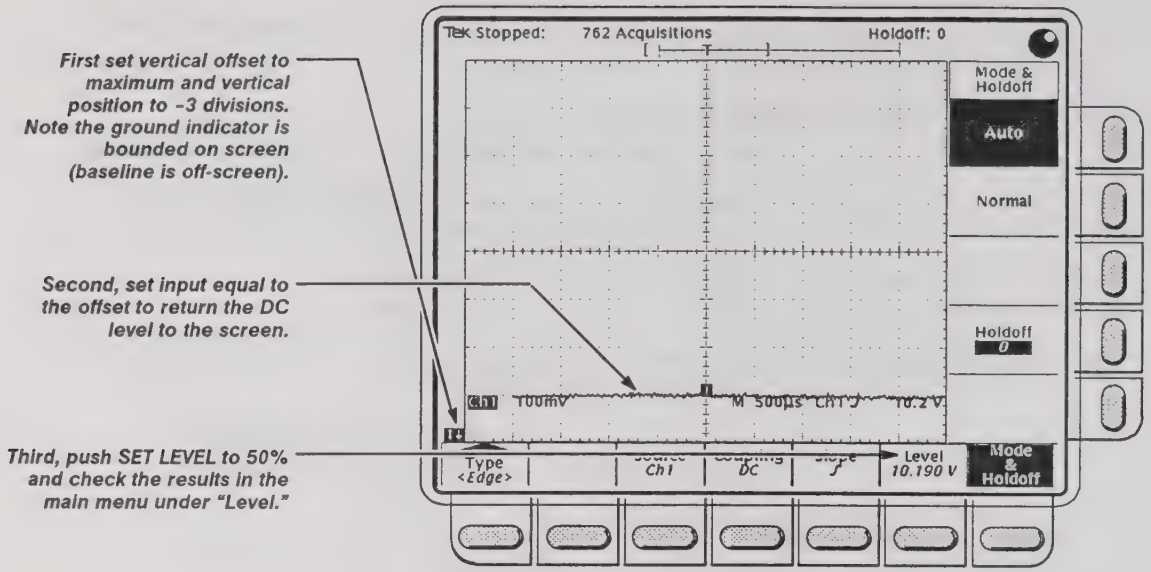

First set vertical offset to maximum and vertical position to -3 divisions. Note the ground indicator is bounded on screen (baseline is off-screen).
Second, set input equal to the offset to return the DC level to the screen.
Third, push SET LEVEL to 50% and check the results in the main menu under "Level."
Tek Stopped: 762 Acquisitions
Holdoff: 0
Mode & Holdoff
Auto
Normal
Holdoff
0
Ch1 100mV
M 500µs Ch1 ƒ 10.2 V
Type <Edge>
Ch1
DC
ƒ
Level 10.190 V
Mode & Holdoff

Figure 4-17: Measurement of Trigger-Level Accuracy

b. *Select the Delayed trigger system:*

- Press **SHIFT**; then press the front-panel button **DELAYED TRIG**.
- Press the main-menu button **Level**.

c. *Measure the test signal:* Press the *side-menu button* **SET TO 50%**. The **TRIG'D** indicator should be lit. Read the measurement results in the side menu below the label **Level**.

d. *Check against limits:* Do the following subparts in the order listed.

- CHECK that the **Level** readout in the side menu is within 9.940 V to 10.060 V, inclusive.
- Press the main-menu button **Slope**; then press the side-menu button for negative slope. (See icon at left.) Press the main-menu button **Level**. Repeat substep c.
- CHECK that the **Level** readout in the side menu is within 9.940 V to 10.060 V, inclusive.

4. *Disconnect the hookup:*

a. *First set the output of the DC calibration generator to 0 volts.*

b. Then disconnect the cable from the generator output at the input connector of **CH 1**.

Sensitivity, Edge Trigger, DC Coupled

Equipment Required: One medium-frequency leveled sine-wave generator (item 10), one high-frequency leveled sine-wave generator, one precision 50 Ω coaxial cable (Item 4), and one 10X attenuator (Item 4). When checking the TDS 520 Digitizing Oscilloscope, a BNC T connector (Item 6), a 5X attenuator (Item 2), and a second precision 50 Ω coaxial cable (Item 4) are also required.

Prerequisites: *See page 4-11.*

Procedure:

1. *Install the test hookup and preset the instrument controls:*

   a. *Initialize the oscilloscope:*

      - Press save/recall **SETUP**.
      - Press the main-menu button **Recall Factory Setup**.
      - Press the side-menu button **OK Confirm Factory Init**.

   b. *Modify the initialized front-panel control settings:*

      - Press **HORIZONTAL MENU**. Now press the main-menu button **Time Base**; then the side-menu button **Delayed Triggerable**.
      - Set the horizontal **SCALE** to 20 ns.
      - Press **TRIGGER MENU**; then press the main-menu button **Mode & Holdoff**. Now press the side-menu button **Normal**.
      - Press **VERTICAL MENU**; then press the main-menu button **Coupling**. Now press the side-menu button Ω select the 50 Ω setting.
      - Press **SHIFT**; then press **ACQUIRE MENU**. Now press the main-menu button **Mode**; then the side-menu button **Average 16**.

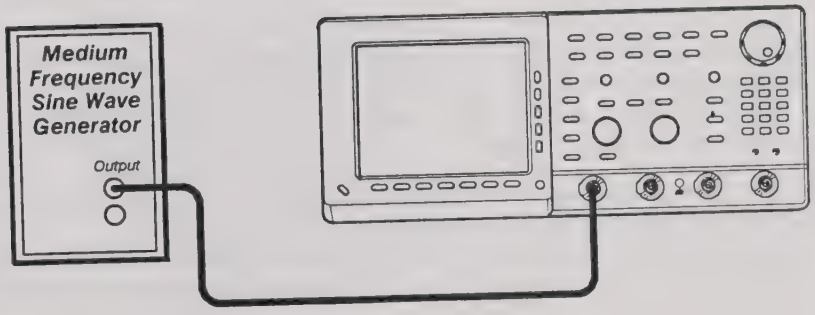


Figure 4-18: Initial Test Hookup

   c. *Hook up the test-signal source*: Connect, through a 50 Ω precision coaxial cable, the signal output of a medium-frequency sine wave generator to **CH 1**.

2. *Confirm Main and Delayed trigger systems are within sensitivity limits (50 MHz)* :

   a. *Display the test signal:*

   - Set the generator frequency to 50 MHz.
   - Press **MEASURE**.
   - Press the main-menu button **High-Low Setup**; then press the side-menu button **Min-Max**.
   - Press the main-menu button **Select Measurement for Ch 1**.
   - Press the side-menu button **-more-** until **Amplitude** appears in the side menu (its icon is shown at the left). Press the side-menu button **Amplitude**.

   - Press **SET LEVEL TO 50%**.
   - Press **CLEAR MENU**.
   - Set the test signal amplitude for about three divisions on screen. Now fine adjust the generator output until the **CH 1 Amplitude** readout indicates the amplitude is 350 mV. (Readout may fluctuate around 350 mV.)
   - Disconnect the 50 Ω precision coaxial cable at **CH 1** and reconnect it to **CH 1** through a 10X attenuator.

   b. *Check for Main trigger system for stable triggering at limits:*

   - Read the following definition: A stable trigger is one that is consistent; that is, one that results in a uniform, regular display triggered on the selected slope (positive or negative). This display should *not* have its trigger point switching between opposite slopes, nor should it "roll" across the screen. At horizontal scale settings of 2 ms/division and faster, **TRIG'D** will remain constantly lit. It will flash for slower settings.
   - Press **TRIGGER MENU**; then press the main-menu button **Slope**.
   - Press **SET LEVEL TO 50%**. CHECK that a stable trigger is obtained for the test waveform on both the positive and negative slopes. (Use the side menu to switch between trigger slopes; use the **TRIGGER LEVEL** knob to stabilize the trigger if required.)
   - Leave the Main trigger system triggered on the positive slope of the waveform before continuing to the next step.

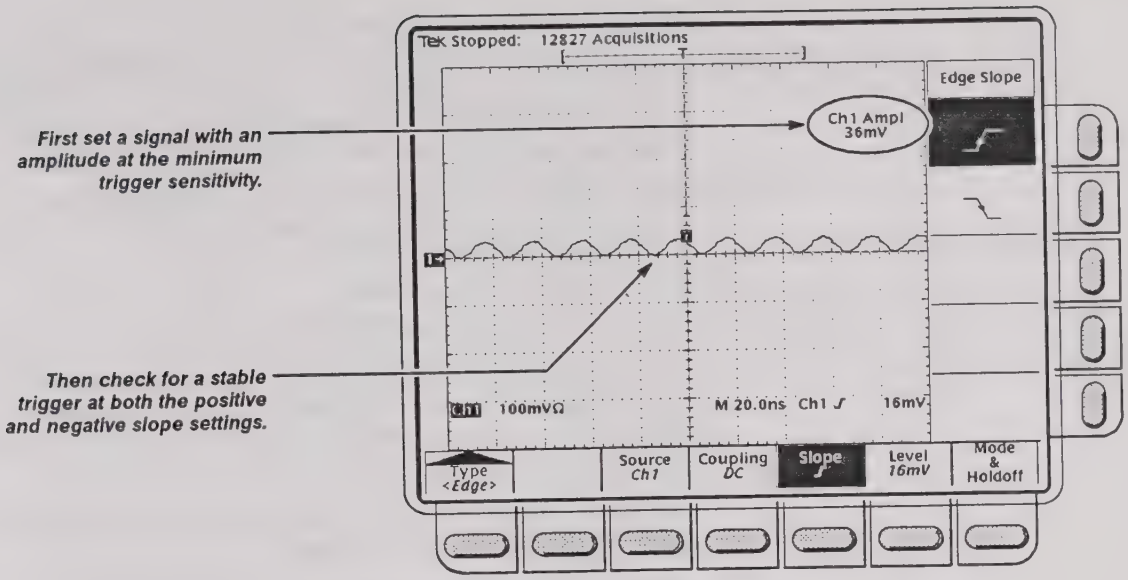

First set a signal with an amplitude at the minimum trigger sensitivity.
Then check for a stable trigger at both the positive and negative slope settings.
Tek Stopped: 12827 Acquisitions
Edge Slope
Ch1 Ampl 36mV
Ch1 100mVΩ
M 20.0ns Ch1 ƒ 16mV
Type <Edge>
Source Ch1
Coupling DC
Slope
Level 16mV
Mode & Holdoff

Figure 4-19: Measurement of Trigger Sensitivity

c. *Check delayed trigger system for stable triggering at limits* Do the following subparts in the order listed.

- Press **HORIZONTAL MENU**; then press the main-menu button **Time Base**. Now press the side-menu button **Delayed Only**.
- Set the horizontal **SCALE** for the delayed time base to **20 ns** if required.
- Press **SHIFT**; then press **DELAYED TRIG**. Press the main-menu button **Level**.
- Press the *side-menu* button **SET TO 50%**. CHECK that a stable trigger is obtained for the test waveform for both the positive and negative slopes of the waveform. (Use the General Purpose knob to stabilize the trigger if required.) Press the main-menu button **Slope**; then use the side menu to switch between trigger slopes.
- Leave the delayed trigger system triggered on the positive slope of the waveform before continuing to the next step. Also, return to the main time base: Press **HORIZONTAL MENU**; then press the main-menu button **Time Base**. Now press the side-menu button **Main Only**.

3. *Confirm that the Main and Delayed trigger systems are within sensitivity limits (500 MHz):*

   a. *Hook up the test-signal source:* Disconnect the hookup installed in step 1. Connect, through its leveling head, the signal output of a high-frequency leveled sine-wave generator to **CH 1**.

b. *Set the Main and Delayed Horizontal Scales:*

- Set the horizontal **SCALE** to 500 ps for the **M** (Main) time base.
- Press **HORIZONTAL MENU**. Now press the main-menu button **Time base**; then press the side-menu button **Delayed Only**.
- Set the horizontal **SCALE** to 500 ps for the **D** (Delayed) time base. Press the side-menu button **Main Only**.

c. *Display the test signal:*

- Set the generator frequency to 500 MHz.
- Set the test signal amplitude for about five divisions on screen. Now fine adjust the generator output until the **CH 1 Amplitude** readout indicates the amplitude is 500 mV. (Readout may fluctuate around 500 mV.)
- Disconnect the 50 Ω precision coaxial cable at **CH 1** and reconnect it to **CH 1** through a 5X attenuator.

d. Repeat step 2, substeps b and c only, since only the 500 MHz frequency is to be checked here.

4. *Confirm that the Main and Delayed trigger systems couple trigger signals from all channels:* If you have not done the procedure *Check Analog Bandwidth,* which begins of page 4-21, do so after finishing this procedure. See the following note.

NOTE

Steps 1 through 3 confirmed trigger sensitivity for the Main and Delayed triggering systems; doing the procedure Check Analog Bandwidth *ensures that trigger signals are coupled from all four channels.*

5. *Disconnect the hookup:* Disconnect the cable from the generator output at the input connector of the channel last tested.

Output Signal Checks

The procedure that follows checks the characteristics of the probe compensation signal that are listed as checked under *Warranted Characteristics* in Section 1, *Specification.*

Check Probe Compensator Outputs

Equipment Required: One standard-accessory 10X probe (item 12).

Prerequisites: See page 4-11. Also, this digitizing oscilloscope must have passed *Check Accuracy — Long-Term Sample Rate, Delay time, Time Measurement* on page 4-28 and *Check Accuracy for DC Gain and Voltage Measurements* on page 4-15 .

Procedure:

1. *Install the test hookup and preset the instrument controls*

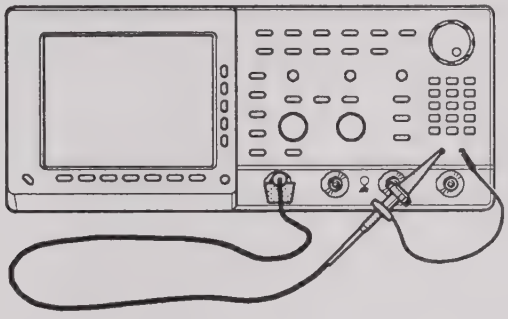


Figure 4-20: Initial Test Hookup

a. *Hook up test-signal:* Install the standard-accessory probe to **CH 1**. Connect the probe tip to **PROBE COMPENSATION SIGNAL** on the front panel; connect the probe ground to **PROBE COMPENSATION GRD**.

b. *Initialize the oscilloscope:*

- Press save/recall **SETUP**.
- Press the main-menu button **Recall Factory Setup**.
- Press the side-menu button **OK Confirm Factory Init**.

c. *Modify the initialized front-panel control settings:*

- Press **AUTOSET**. Set the horizontal **SCALE** to 200 μs.
- Press **SHIFT**; then press **ACQUIRE MENU**.
- Press the main-menu button **Mode**; then press the side-menu button **Hi Res**.

2. *Confirm that the Probe Compensator signal is within limits for amplitude and frequency:*

   a. *Measure amplitude and frequency of the probe compensation signal:*

   - Press **MEASURE**; then press the main-menu button **Select Measurement for Ch 1**.

   - Repeatedly press the side-menu button **-more-** until **Frequency** appears in the side menu (its icon is shown at the left). Press the side-menu button **Frequency**.

   - Now repeatedly press the side-menu button **-more-** until **Amplitude** appears in the side menu (its icon is shown at the left). Press the side-menu button **Amplitude**.
   - Press **CLEAR MENU** to remove the menus from the display. See Figure 4-21.

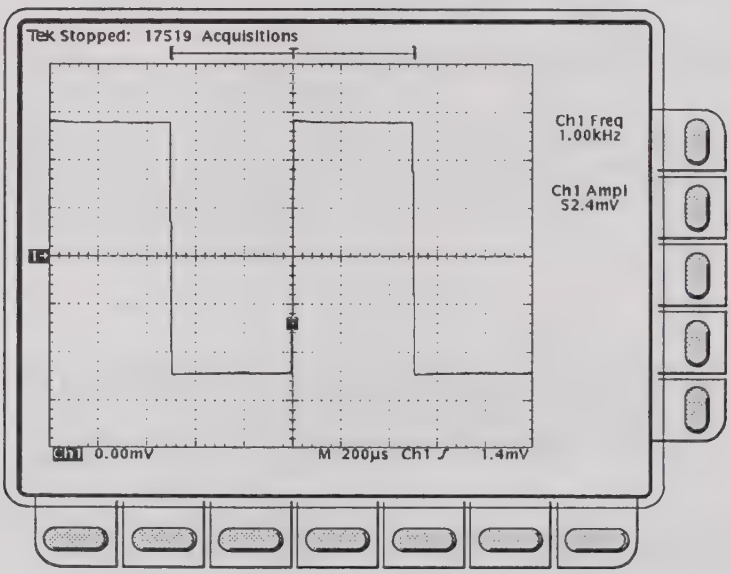


Figure 4-21: Measurement of Probe Compensator Limits

   b. *Check against limits:* CHECK that the **CH 1 Freq** readout is within 950 Hz to 1.050 kHz, inclusive, and that the readout for **Ch 1 Ampl** is within 475 mV to 525 mV, inclusive.

Adjustment Procedures

This section contains information needed to adjust your TDS 520 Digitizing Oscilloscope.

Description – The *Adjustment Procedures* are divided into three parts:

- This general information about adjusting this oscilloscope and the written procedures for installing and using the *TDS 520/540 Adjustment Software*.
- The *TDS 520/540 Adjustment Software* included with this manual. The material found in this section should be read before using the adjustment software.
- Two written procedures for manually adjusting the probe and the monitor assembly.

Purpose – This procedure is used to return the oscilloscope to conformance with its *Warranted Characteristics* as listed in Section 1, *Specification*. It can also be used to optimize the performance of the oscilloscope.

Adjustment Interval – As a general rule, these adjustments should be performed every 2000 hours of operation or once a year if used infrequently.

Requirements for Performance

Before you perform this procedure, you need to address the following requirements.

Personnel

This procedure is only to be performed by trained service technicians.

Warm-up Period

This oscilloscope requires a 20 minute warm-up time in a 20°C to 30°C environment before performing this adjustment procedure. Adjustments performed before the operating temperature has stabilized may cause errors in adjustment.

Access

Except when adjusting the monitor, cabinet removal is not required or recommended to adjust this oscilloscope. You must, however, enable its internal adjustment constants to be written. Two small holes in the chassis allow service personnel to insert a tool and push a switch to enable or disable the writing of new adjustment constants to non-volatile RAM.

The procedure that follows will tell you how and when to enable and disable adjustment; be sure to disable adjustment when you have finished adjusting the oscilloscope.

System

The following computer and peripherals are required to adjust this oscilloscope.

Computer – A IBM® PC™ or a strict compatible is required. The system must also be equipped as follows:

- Eight MHz clock speed or faster.
- DOS 3.2 or higher.
- 640K Resident RAM.
- A hard drive.
- 3.5 inch double-density floppy drive.
- A GPIB board—National Instruments® GPIB-PCII/IIA or a PC-GPIB Package (Tektronix part number 118-8688-00).
- Suitable keyboard and monitor.

Optional Peripherals

Installation of a math coprocessor in your system is strongly recommended to decrease the time required to adjust the oscilloscope. Although not required, a printer is useful for obtaining a hard copy of adjustment results.

Test Equipment

The equipment list at the end of this section lists all test equipment required to adjust this oscilloscope.

Usage

The following topics cover what is required of you when adjusting the oscilloscope and what is done by the software. Also, the performance of individual adjustments is discussed.

Performing the Adjustments

When using the adjustment software, you will not be required to manually adjust any circuits. The software adjusts the circuits using external standards you provide in response to prompts on the computer screen. Your role, then, is to provide those test signals and to prompt the computer to continue.

Since the probe and monitor adjustments require manual adjustment of circuit components, they are not part of the adjustment software. Written procedures for these adjustments appear at the end of this section.

Complete Adjustment

A complete adjustment is defined as the performance of all adjustments on the *TDS 520/540 Adjustment Software* plus the probe adjustment on page 5-9. Therefore to do a complete adjustment, *do all adjustments in the software, completely and in sequence, then do the written probe adjustment procedure.*

Throughout this section, "complete adjustment" is used as just defined.

Note that complete adjustment may not require manually adjusting the probe; see *Probe Adjustment* later in this section.

Individual Adjustments

As was previously implied, the adjustment software contains a sequence of individual adjustments. The list of those adjustments follows.

- Controlled-Voltage Reference (CVR) Adjustment.
- Clock Interleave Adjustment
- Bandwidth Adjustment
- Glitch Trigger Adjustment

All these software-based adjustments are made internally by the adjustment software, and all adjustments can be done without removal of the oscilloscope cabinet.

Signal Path Compensation – Performing the Controlled-Voltage Reference Adjustment (CVR) automatically runs the Signal Path Compensation. This internal routine is not an adjustment. It is a temperature compensation routine that compensates for current operating temperature to optimize oscilloscope performance. Signal Path Compensation runs automatically when a CVR adjustment is performed to optimize the adjustments that follow for the current temperature.

Partial Adjustment

The adjustment software will allow you to make individual adjustments; however, usually all adjustments are made unless you are adjusting circuits in the course of troubleshooting the oscilloscope. Read the information under *Complete Adjustment*, *Adjustment After Repair,* and *Adjustment Dependencies* before doing an individual adjustment.

Adjustment After Repair

After the removal and replacement of a defective module due to electrical failure, you must either do a complete adjustment or no adjustment is required, depending on the module replaced. See Table 5-1.

Table 5-1: Adjustments Required for Module Replaced

Module Replaced	Adjustment Required
Acquisition Board	Complete Adjustment
Attenuator Board	Complete Adjustment
Front Panel Assembly	None Required
Firm Face Board	Typically none required
Low Voltage Power Supply	Complete Adjustment
Processor Board	Complete Adjustment
Monitor/Display Module	Monitor Adjustment Only

Adjustment Dependencies

Some adjustments depend on the successful prior completion of other adjustments. For example, the Controlled Voltage Reference (CVR) adjustment must be passed before most any other adjustments can be successfully completed. The following table lists the adjustments and their dependencies.

Table 5-2: Adjustments and Dependencies

Adjustment	Prior Completion Requirements
Controlled-Voltage Reference Adjustment	None
Clock Interleave Adjustment	CVR
Bandwidth Adjustment	CVR and Clock Interleave
Glitch Trigger Adjustment	CVR
Probe Adjustment	CVR, Clock Interleave, and Bandwidth
Monitor Adjustment	None

Equipment Required

The test equipment required to adjust the TDS 520 Digitizing Oscilloscope is listed here.

Table 5-3: Test Equipment

Item Number and Description	Minimum Requirements	Example	Purpose
1 Adapter, BNC-Female-to-BNC-Female	Tektronix 013-0028-00	Tektronix 013-0028-00	Probe Adjustment
2 Adapter, Probe Tip to BNC, 50 Ω termination	Tektronix 013-0227-00	Tektronix 013-0227-00	Probe Adjustment
3 Adjustment Tool	Less than 1/8 inch diameter and over 2 inches long	Tektronix 003-0675-00	Software-based Adjustments (used as a probe) and Manual Adjustments
4 Attenuator,10X (Two required)	Ratio: 10X; impedance 50 Ω; connectors: female BNC input, male BNC output	Tektronix part number 011-0059-02	Software-based Adjustments
5 Attenuator,2X	Ratio: 2X; impedance 50 Ω; connectors: female BNC input, male BNC output	Tektronix part number 011-0069-02	Software-based Adjustments
6 Cable GPIB	IEEE 488.1-1987/IEEE 488.2-1987	Tektronix part number 002-0991-01	Software-based Adjustments
7 Coupler, Dual Input		Tektronix part number 067-0525-02	Software-based Adjustments
8 Cable, Precision Coaxial	50 Ω, 36 in, male to male BNC connectors	Tektronix part number 012-0482-00	Software-based Adjustments
9 Connector, Dual-Banana	Female BNC to dual banana	Tektronix part number 103-0090-00	Software-based Adjustments
10 Generator, DC Calibration	Variable amplitude to ±10 V; accuracy to 0.05%	Data Precision 8200	Software-based Adjustments
11 Generator, Leveled Sine-Wave, Medium-Frequency	200 kHz to 250 MHz; Variable amplitude from 5 mV to 4 V p-p into 50 Ω	TEKTRONIX SG 503 Leveled Sine Wave Generator	Software-based Adjustments
12 Generator, Leveled Sine-Wave, High-Frequency	250 MHz to 500 MHz; Variable amplitude from 5 mV to 4 V p-p into 50 Ω; 6 MHz reference	TEKTRONIX SG 504 Leveled Sine Wave Generator with SG 504 Output Head	Software based Adjustments
13 Magnifier	6X		Brightness and Focus Adjustment

Table 5-3: Test Equipment (Cont.)

Item Number and Description	Minimum Requirements	Example	Purpose
14 Photometer	0.1 to 200 Footlamberts	TEKTRONIX J16 with J6503 Luminance Probe	Contrast Adjustment
15 Generator, Pulse	High Amplitude pulse with variable amplitude of 60 V to 100 V.	TEKTRONIX PG 506 Calibration Generator	Probe Adjustment
16 Pulser, Tunnel Diode	TEKTRONIX 067-0681-01	TEKTRONIX 067-0681-01	Probe Adjustment

Adjustment Instructions

The following instructions will guide you through installing the software on your system, setting up the oscilloscope for adjustment, and starting the adjustment of the oscilloscope by the software.

Hardware Installation

1. *Install the proper GPIB card (see* System *on page 5-2):* Use the manual accompanying your GPIB card to install and configure that card.
2. *Configure the GPIB card:*
   a. This software is designed to be compatible with cards configured for PCIIA operation. The following table lists the default card settings.
   b. If these setting conflict with your hardware setup, see your GPIB card manual for alternate settings.

Table 5-4: GPIB Board Configuration

Board Settings	GPIB-PCIIA
Base I/O Address (hex)	2E1
Interrupt Line	7
DMA Channel	1

   c. If you have more than one GPIB card installed, this adjustment software assumes the first card (referenced 0). See your GPIB card manual for information on how to determine which card is your "0" cared.

Software Installation

1. *Create a working disk:* Using the appropriate DOS commands, copy the 3.5 inch disk *TDS 520/540 Adjustment Software* to a working disk.
2. *Install the software to hard disk:*
   a. Install your working disk in a floppy drive and type *install*, then the letter designating your hard drive. For example, *install c.*
   b. The adjustment software will be installed in a directory called *TEK-CATS* on your hard drive.
3. *Store your installation disk:* Remove your installation disk and store in a secure place.

Adjustment Procedure

Equipment Required: All items for which "Software-based Adjustments" is listed under "Purpose" in Table 5-3 on page 5-5.

1. *Hook up the oscilloscope:*
   a. Connect the GPIB cable (item 6) to the GPIB port at the computer rear panel. (When multiple GPIB cards are installed, connect to the GPIB0 card.)
   b. Connect the GPIB cable (item 6) to the GPIB port at the oscilloscope rear panel.
   c. Power on the oscilloscope.
   d. Power on and boot your system.
2. *Set up the oscilloscope:*
   a. Press **SHIFT**; then press **UTILITY**.
   b. Repeatedly press the main-menu button **System** , until **I/O** is highlighted in the pop up menu.
   c. Press the side-menu button **TALK/LISTEN**.
   d. Use the keypad to set any address between 0 and 29.
3. *Enable the adjustment constants to be written:*
   a. Locate the two small access holes on the right side of the oscilloscope cabinet near the front.
   b. Insert the adjustment tool (item 3) in the hole nearest the front of the oscilloscope about ½ inch to engage the rocker switch.
   c. Push to rock the switch to its enabled position.
4. *Let the oscilloscope warm up.* Allow a 20 minute warm up period before you begin step 5.

5. *Start the adjustment software:*
   a. Change drives to your hard drive.
   b. Change directories to TEKCATS.
   c. Type *TDSADJ.*
   d. Follow the instructions as prompted on your computer screen.
6. *When adjustment is completed:*

CAUTION

Be sure to disable the writing of the adjustment constants as instructed below to protect them against alteration.

   a. Locate the two small access holes on the right side of the oscilloscope cabinet near the front.
   b. Insert the adjustment tool (item 3) in the hole nearest the *rear* of the oscilloscope about ½ inch to engage the rocker switch.
   c. Push to rock the switch to its disabled position.
   d. To do a complete adjustment as defined on page 5-3, do the procedure *Probe Adjustment* on page 5-9.

Probe Adjustment

Probe adjustment is divided into three parts: *Compensate the Probe, Measure the Probe Bandwidth*, and *Adjust the Probe — High Frequency Response.* If probe bandwidth is within required limits, you will be instructed to *not* do the high frequency response adjustment.

Compensate the Probe

Equipment Required: None, except the P6139 probe.

Procedure:

1. *Install the test hookup and preset the oscilloscope controls:*

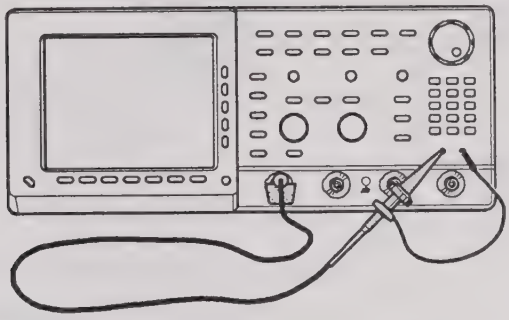


Figure 5-1: Hookup for Probe Compensation

a. *Hook up test-signal source:* Install the standard-accessory probe to **CH 1**. Connect the probe tip to **PROBE COMPENSATION SIGNAL** on the front panel; connect the probe ground to **PROBE COMPENSATION GRD**.

b. *Initialize the oscilloscope:*

- Press save/recall **SETUP**.
- Press the main-menu button **Recall Factory Setup**.
- Press the side-menu button **OK Confirm Factory Init**.

c. *Modify the initialized front-panel control settings:*

- Press **AUTOSET**. Set the horizontal **SCALE** to 200 μs.
- Press **SHIFT**; then press **ACQUIRE MENU**.
- Press the main-menu button **Mode**; then press the side-menu button **Hi Res**.

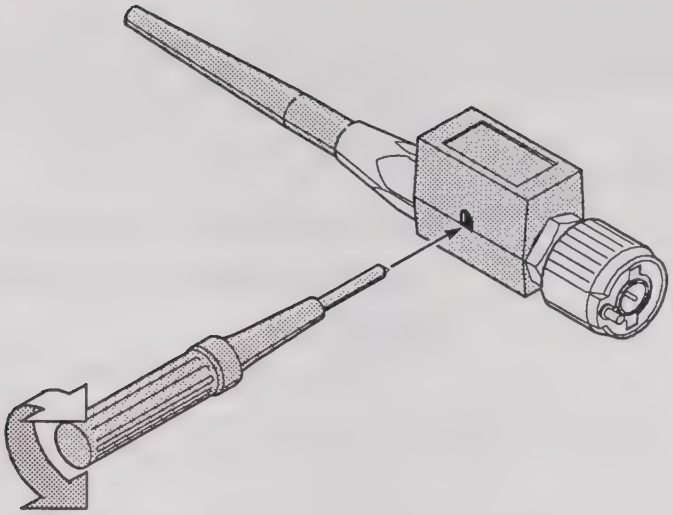


Figure 5-2: Performing Probe Compensation

2. *Compensate the Probe:*
   a. Locate the probe compensation hole in the side of the probe body.
   b. Using the probe compensation tool, adjust the probe for best square wave compensation (flat as possible across its across its top).

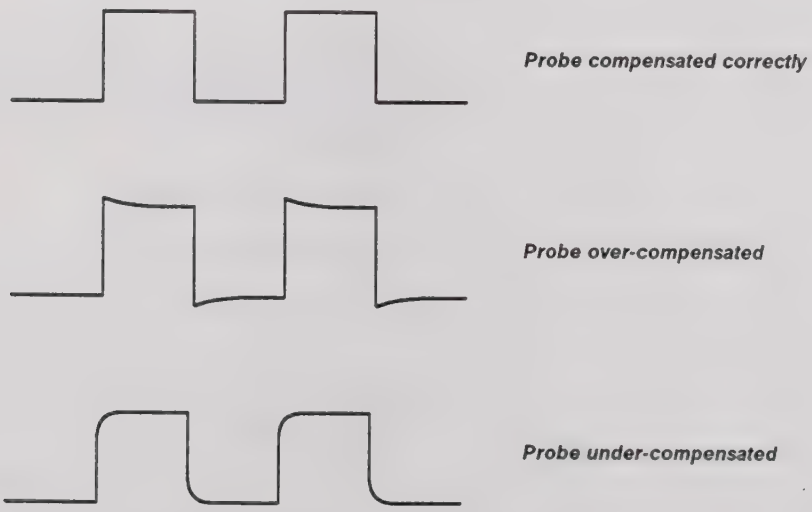


Figure 5-3: Proper and Improper Probe Compensation

3. *Disconnect the hookup:* Disconnect the probe from the probe compensator terminals; leave probe installed on CH 1 and leave the oscilloscope control setup as is for doing the next part of probe adjustment.

Measure Probe Bandwidth

Equipment Required: One high-frequency sine wave generator (Item 12), one 50 Ω precision cable (Item 8), one tunnel diode pulser (Item 16), one 10X attenuator (Item 4), one BNC-female-to-female BNC adapter (Item 1), one BNC-to-probe tip adapter (Item 2), and one P6139 10X probe (Item 12).

Procedure:

1. *Install the test hookup and preset the oscilloscope controls:*

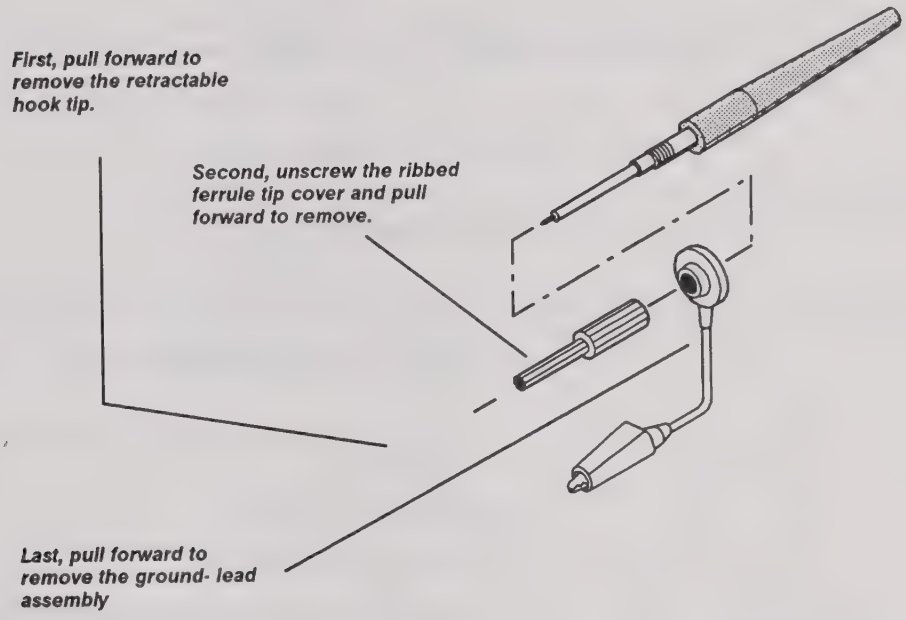

First, pull forward to remove the retractable hook tip.
Second, unscrew the ribbed ferrule tip cover and pull forward to remove.
Last, pull forward to remove the ground- lead assembly

Figure 5-4: Exposing the Inner Probe Tip

a. *Expose the Inner Probe Tip:* Follow the instructions in Figure 5-4.

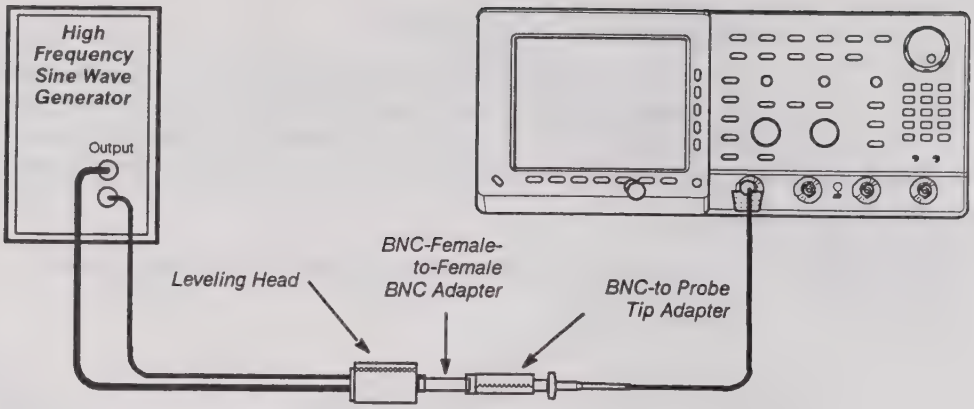


Figure 5-5: Initial Test Hookup

b. *Hook up test-signal source:*

- Connect the output of a high-frequency sine wave generator, through its leveling head, to a female-to-female adapter.
- Connect the female-to-female adapter to a BNC-to-probe tip adapter.
- Plug the probe tip from the probe on CH 1 into the BNC-to-probe tip adapter.

c. *Initialize the oscilloscope:*

- Press save/recall **SETUP**.
- Press the main-menu button **Recall Factory Setup**.
- Press the side-menu button **OK Confirm Factory Init**.

d. *Modify the initialized front-panel control settings:*

- Set the vertical **SCALE** to 50 mV.
- Set the horizontal **SCALE** to 100 ns.
- Press the side-menu button **Coupling**; the press the side-menu button Ω to toggle to the 50 Ω setting.
- Press **SHIFT**; then press **ACQUIRE MENU**.
- Press the main-menu button **Mode**; then press the side-menu button **Hi Res**.
- Press **MEASURE**; then press the main-menu button **Select Measurement for Ch 1**.
- Repeatedly press the side-menu button **-more-** until **Pk-Pk** appears in the side menu. Press the side-menu button **Pk-Pk**.
- Press **CLEAR MENU**.

2. *Confirm that the Probe Compensator signal is within limits for bandwidth:*

   a. *Display and measure the test signal:*

      - Monitor the **CH 1 Pk-Pk** readout while you set the output of the generator for a 3.0 V (6 division), 6 MHz reference signal.
      - Set the horizontal **SCALE** to 1 ns and set the frequency of the generator to 400 MHz.
      - Read the measurement results at the CH 1 Pk-Pk readout on screen.

   b. *Check against limits:* CHECK that the **CH 1 Pk-Pk** readout is greater than or equal to 2.1 V.

3. *Disconnect the hookup:*

   a. Unplug the probe from BNC-to-probe tip adapter.

   b. If substep 2b was passed, the probe adjustment is finished. Reverse the instructions in Figure 5-4, page 5-11, to reinstall the retractable hook probe tip.

   c. If substep 2b was *not* passed, leave the probe tip exposed. Remove the probe from CH 1 and go on to the next procedure *Adjust the Probe—High Frequency Response*.

Adjust the Probe — High Frequency Response

Do not perform this procedure until you have first completed the procedures *Compensate the Probe* and *Measure Probe Bandwidth* on pages 5-9 and 5-11, respectively.

Do not perform this procedure if you have successfully completed *Measure Probe Bandwidth.* Instead,

Procedure:

1. *Install the test hookup and preset the oscilloscope controls*

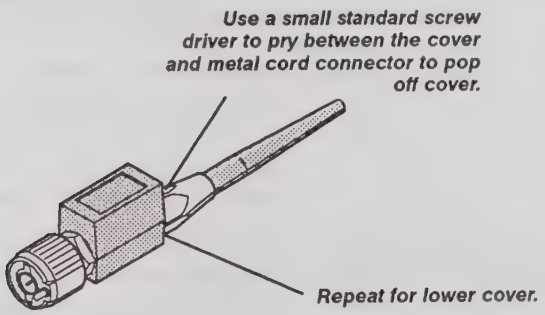

Use a small standard screw driver to pry between the cover and metal cord connector to pop off cover.
Repeat for lower cover.

Figure 5-6: Exposing the Probe Body

a. *Access Inner Probe Tip and Adjustment Ports:*

- The probe tip should be exposed from the procedure *Measure Probe Bandwidth.* If not, follow the instructions in Figure 5-4 to expose.
- Follow the instructions in Figure 5-6 to remove the probe body covers.

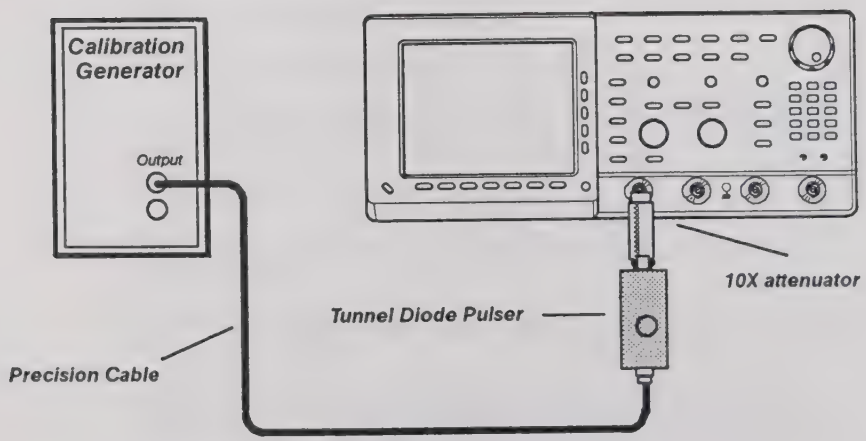


Figure 5-7: Initial Test Hookup

b. *Initialize the oscilloscope:*

- Press save/recall **SETUP**.
- Press the main-menu button **Recall Factory Setup**.
- Press the side-menu button **OK Confirm Factory Init**.

c. *Modify the initialized front-panel control settings:*

- Set vertical **SCALE** to 5 mV.
- Press **VERTICAL MENU**; then press the main-menu button **Coupling**. Press the side-menu button Ω to toggle to 50 Ω coupling.
- Press **SHIFT**; then press **ACQUIRE MENU**.
- Press the main-menu button **Mode**; then press the side-menu button **Hi Res**.
- Press **CLEAR MENU**.

2. *Adjust the Probe:*

a. *Display and store the reference signal:*

- Set the high-amplitude output of the generator 60 to 100 V *at the input to the tunnel diode pulser*.
- Advance the triggering level of the tunnel diode pulser until a five to six division square wave appears on screen.
- Push **SET LEVEL TO 50%** as required to trigger the signal.
- Advance the horizontal **SCALE** to 5 ns.
- Press **HORIZONTAL MENU**.
- Press the main-menu button **Trigger Position**; and press the side-menu button **20%**.
- Push **SHIFT**; then press **SAVE WAVEFORM**.
- Press the main-menu button **Save Waveform**; then press the side-menu button **To Ref 1**.
- Press **MORE**; then push the main-menu button **Ref 1**.

b. *Display the test signal:*

- Press the main-menu button **Coupling**; then press the side-menu button Ω to toggle to 1 M Ω coupling.
- Press **HORIZONTAL MENU**.
- Press the main-menu button **Trigger Position**; and press the side-menu button **50%**.

c. *Make the adjustments*

- Locate the various adjustments in Figure 5-8.
- Manually adjust the front-corner response of the probe to best match the response of the Ref 1 waveform.

- See Figure 5-9 to see what areas on the front corner that the various adjustments affect.

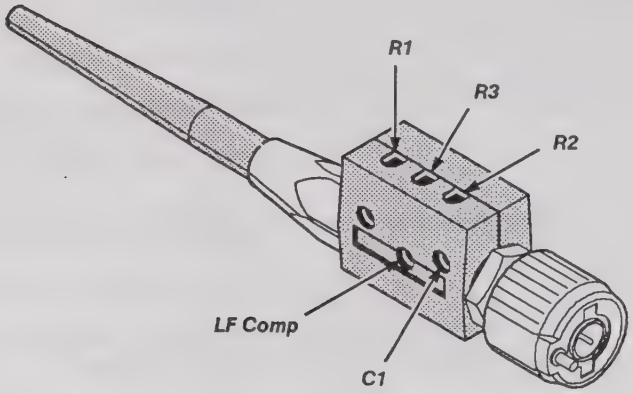


Figure 5-8: Locations of Probe Adjustments

d. *Recheck Probe Bandwidth:*

- Redo the procedure *Adjust Probe — High Frequency Response* to check if probe now meets its bandwidth requirement.
- If bandwidth is met, adjustment is complete. Skip to step 3.
- If bandwidth is *not* met, redo this procedure, increasing front corner overshoot slightly relative to the stored waveform.
- Repeat this step (d) until bandwidth is met.

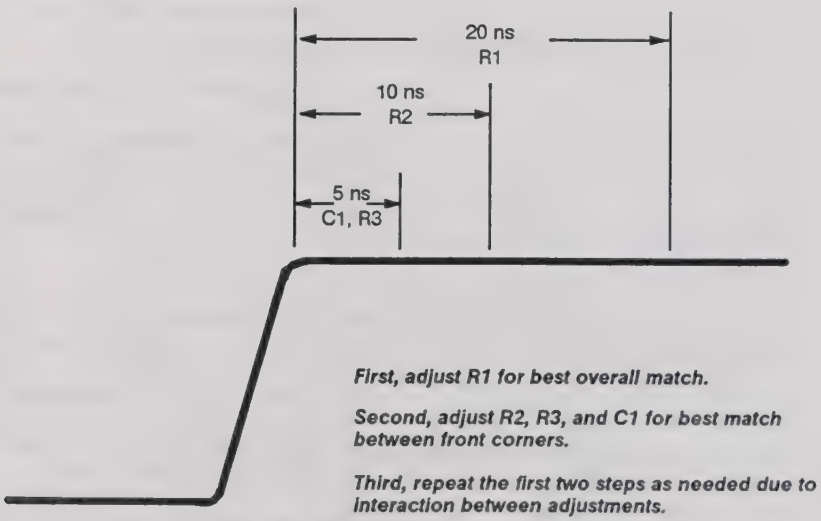

20 ns
R1
10 ns
R2
5 ns
C1, R3
First, adjust R1 for best overall match.
Second, adjust R2, R3, and C1 for best match between front corners.
Third, repeat the first two steps as needed due to interaction between adjustments.

Figure 5-9: Adjustments vs. Front-corner Response

3. *Disconnect the hookup:* Unplug the probe from the BNC-to-probe tip adapter. Reverse the instructions in Figure 5-4, page 5-11, to reinstall the retractable probe tip.

Monitor Assembly Adjustment

It is not necessary to do this procedure to perform a complete adjustment. Only use this procedure to adjust the monitor assembly if it has been repaired or if brightness and contrast have become unsatisfactory.

The equipment required to do this procedure is listed in Table 5-3.

Brightness and Contrast Adjustment

Equipment Required: One 6X magnifier (Item 13) and on J16 Photometer with a J6503 Luminance Probe (Item 14).

Procedure:

1. *Access the inside of the oscilloscope:* See *Removal and Installation Procedures* in Section 6 to remove the cabinet.
2. *Adjust the display brightness:*
   a. *Display the Composite test pattern:*
      - Leave the oscilloscope powered off.
      - Set the DIP switch, located near the front of the A11 DRAM Processor/Display, as follows:

Switch No.	1	2	3	4	5	6	7	8
Open						X	X	
Closed	X	X	X	X	X			X

      - Power on the oscilloscope.
      - Press **SHIFT** and **UTILITY**.
      - Repeatedly press the main-menu button **System** until **Diag/Err** is highlighted in the pop up menu.
      - Repeatedly press the main-menu button **Area** until **Display** is highlighted in the pop up menu.
      - Repeatedly press the side-menu button **-more-** until **Composite** appears in the side menu. Push **Composite**.
      - Press the main-menu button **EXECUTE**; then the side-menu button **Ok Confirm Run Test**.

b. *Make the brightness adjustment:*

- Locate R569 (BRIGHTNESS). It is one of two adjustments on the left side of the instrument located just ahead of the fan. It is the adjustment nearest the fan.
- Observe the luminance patches using a 6X magnifier.
- Adjust R569 (BRIGHTNESS) until the background raster lines in the 5% luminance patch (see Figure 5-10) just disappear, while the lines in the 10% luminance patch are just visible, when both are viewed through the magnifier.

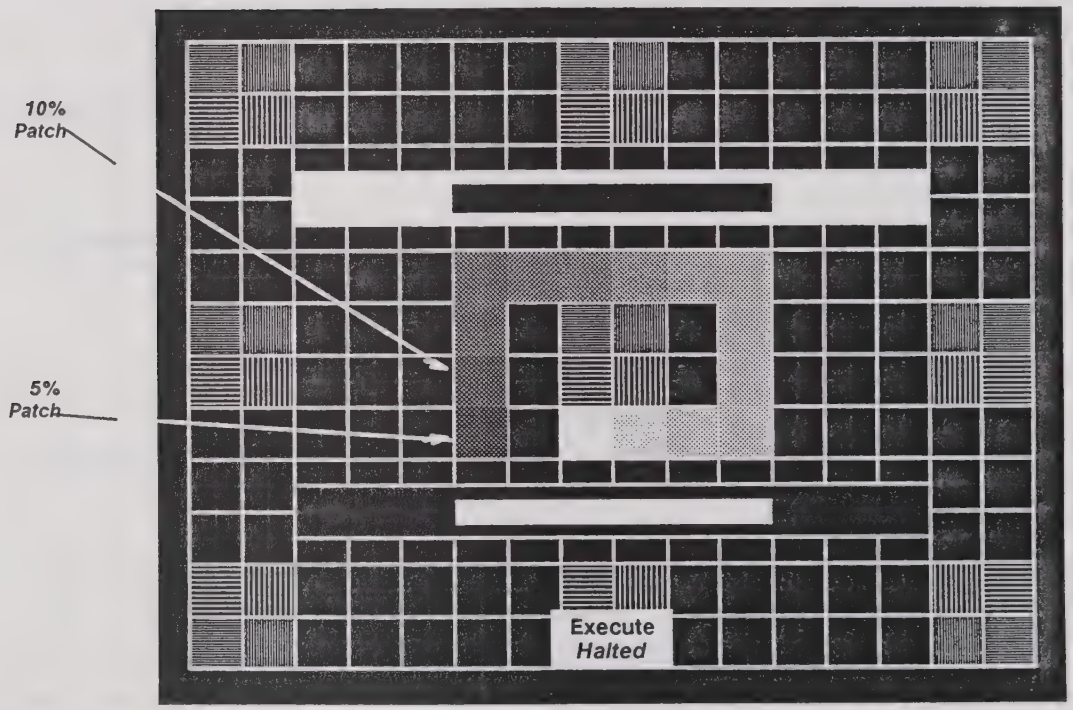


Figure 5-10: Five and ten percent luminance patches.

3. *Adjust the display contrast:*

   a. *Display the White Field test pattern:*

   - Press the center main-menu button to display the main-menu.
   - Press the main-menu button **Tests**.
   - Repeatedly press the side-menu button **-more-** until **White Field** appears in the side menu. Push **White Field**.
   - Press the main-menu button **EXECUTE**; then the side-menu button **Ok Confirm Run Test**.

b. *Make the contrast adjustment:*

- Locate R572. It is one of two adjustments on the left side of the instrument located just ahead of the fan. It is the adjustment nearest the front of the oscilloscope.
- Monitor the luminance at center screen using a J16 photometer and a luminance probe.
- Adjust R572 (CONTRAST) for a reading of 50 foot lamberts if the gray display shield is installed; adjust for 110 foot lamberts if shield is missing.

4. *Restore the oscilloscope to normal operation:*

a. Restore the dip switch to the settings that follow:

Switch No.	1	2	3	4	5	6	7	8
Open	X			X	X		X	
Closed		X	X			X		X

b. Power off the oscilloscope.

c. See *Removal and Installation Procedures* in Section 6 to reinstall the cabinet and other modules removed in step 1.

Maintenance Information

This section contains the information needed to do periodic and corrective maintenance on the TDS 520 Digitizing Oscilloscope. Specifically, the following subsections are included:

Maintenance Information – This subsection. It includes this introduction plus general information on preventing damage to internal modules when doing maintenance.

Inspection and Cleaning – Information and procedures for inspecting the oscilloscope and cleaning its external and internal modules.

Removal and Installation Procedures – Procedures for the removal of defective modules and replacement of new or repaired modules. Also included is a procedure for disassembly of the oscilloscope for cleaning.

Troubleshooting – Information for isolating failed modules. Included are instructions for operating the oscilloscope internal diagnostic routines and troubleshooting trees. Most of the trees make use of these internal diagnostic routines to speed fault isolation to a module.

Procedures Not In This Section

The following sections contain information/procedures related to doing maintenance.

- Section 2, *Operating Information*, covers instructions useful when operating the oscilloscope in order to troubleshoot it. It also details the service strategy and lists options for obtaining maintenance service and for replacing failed modules.
- Section 3, *Theory of Operation*, contains a circuit description at the module, or block, level.
- Section 4, *Performance Verification*, contains procedures that may be useful in isolating problems to modules by testing oscilloscope performance.
- Section 5, *Adjustment Procedures*, addresses after repair adjustment and the interval between periodic adjustments. It contains a procedure for adjusting the internal circuits of this oscilloscope.
- Section 9, *Diagrams*, contains a block diagram using individual modules as blocks and an interconnection diagram showing connections between the modules.
- Section 10, *Replaceable Parts,* lists all field replaceable modules by part number.

Preventing ESD

CAUTION

Static discharge can damage any semiconductor component in this oscilloscope.

Precautions

When performing any service which requires internal access to the oscilloscope, adhere to the following precautions to avoid damaging internal modules and their components due to electrostatic discharge (ESD).

1. Minimize handling of static-sensitive modules.
2. Transport and store static-sensitive modules in their static protected containers or on a metal rail. Label any package that contains static-sensitive modules.
3. Discharge the static voltage from your body by wearing a grounded antistatic wrist strap while handling these modules. Do service of static-sensitive modules only at a static-free work station.
4. Nothing capable of generating or holding a static charge should be allowed on the work station surface.
5. Handle circuit boards by the edges when possible.
6. Do not slide the modules over any surface.
7. Avoid handling modules in areas that have a floor or work-surface covering capable of generating a static charge.

Susceptibility to ESD

Table 6-1 lists the relative susceptibility of various classes of semiconductors. Static voltages of 1 kV to 30 kV are common in unprotected environments.

Table 6-1: Relative Susceptibility to Static-Discharge Damage

Semiconductor Classes	Relative Susceptibility Levels[1]
MOS or CMOS microcircuits or discrete circuits, or linear microcircuits with MOS inputs (Most Sensitive)	1
ECL	2
Schottky signal diodes	3
Schottky TTL	4
High-frequency bipolar transistors	5
JFET	6
Linear microcircuits	7
Low-power Schottky TTL	8
TTL (Least Sensitive)	9

[1]Voltage equivalent for levels (voltage discharged from a 100 pF capacitor through resistance of 100 Ω):

1 = 100 to 500 V
2 = 200 to 500 V
3 = 250 V
4 = 500 V
5 = 400 to 600 V
6 = 600 to 800 V
7 = 400 to 1000 V (est.)
8 = 900 V
9 = 1200 V

Inspection and Cleaning

Inspection and Cleaning describes how to inspect for dirt and damage on, and how to clean the exterior and interior of, the TDS 520 Digitizing Oscilloscope. Such inspection and cleaning are performed as preventative maintenance. Preventive maintenance, when performed regularly, may prevent oscilloscope malfunction and enhance oscilloscope reliability.

Preventive maintenance consists of visually inspecting and cleaning the digitizing oscilloscope and using general care when operating it.

The severity of the environment in which the oscilloscope is used determines the required frequency of maintenance. An appropriate time to perform preventive maintenance is just before oscilloscope adjustment.

General Care

The cabinet minimizes accumulation of dust inside the oscilloscope and should normally be in place when operating the oscilloscope. The oscilloscope's front cover protects the front panel and display from dust and damage. It should be installed whenever the oscilloscope is stored or transported.

Inspection and Cleaning Procedures

The scope should be visually inspected and cleaned as often as operating conditions require. Accumulation of dirt in the oscilloscope can cause overheating and component breakdown. Dirt on components acts as an insulating blanket, preventing efficient heat dissipation. It also provides an electrical conduction path that could result in oscilloscope failure, especially under high-humidity conditions.

CAUTION

Avoid the use of chemical cleaning agents which might damage the plastics used in this oscilloscope. Use only deionized water when cleaning the menu or front panel buttons. Use a 75% isopropyl alcohol solution as a cleaner and rinse with deionized water. Before using any other type of cleaner, consult your Tektronix Service Center or representative.

Inspect Exterior

Inspection – Inspect the outside of the oscilloscope for damage, wear, and missing parts, using Table 6-2 as a guide. Oscilloscopes that appear to have been dropped or otherwise abused should be checked thoroughly to verify correct operation and performance. Repair deficiencies that could cause personal injury or lead to further damage to the oscilloscope immediately.

CAUTION

To prevent getting moisture inside the oscilloscope during external cleaning, use only enough liquid to dampen the cloth or applicator.

Table 6-2: External Inspection Check List

Item	Inspect For	Repair Action
Cabinet, Front Panel, and Cover	Cracks, scratches, deformations, damaged hardware or gaskets.	Replace defective module.
Front-panel Knobs	Missing, damaged, or loose knobs.	Repair or replace missing or defective knobs.
Connectors	Broken shells, cracked insulation, and deformed contacts. Dirt in connectors.	Replace defective modules. Clear or wash out dirt.
Carrying Handle, bail, cabinet feet.	Correct operation.	Replace defective module.
Accessories	Missing items or parts of items, bent pins, broken or frayed cables and damaged connectors.	Replace damaged or missing items, frayed cables, and defective modules.

Cleaning Procedure—Exterior

1. Remove loose dust on the outside of the oscilloscope with a lint free cloth.
2. Remove remaining dirt with a lint free cloth dampened in a general purpose detergent-and-water solution. Do not use abrasive cleaners.
3. Clean the light filter protecting the monitor screen with a lint-free cloth dampened with either isopropyl alcohol or, preferably, a gentle, general purpose detergent-and-water solution.

Inspect Interior

To access the inside of the oscilloscope for inspection and cleaning, refer to the *Removal and Installation Procedures* in this section.

Inspect the internal portions of the digitizing oscilloscope for damage and wear, using Table 6-3 as a guide. Deficiencies found should be repaired immediately.

If any electrical module is replaced, check Table 5-1 in Section 5 to see if it is necessary to adjust the oscilloscope.

CAUTION

To prevent damage from electrical arcing, ensure that circuit boards and components are dry before applying power to the oscilloscope.

Table 6-3: Internal Inspection Check List

Item	Inspect For	Repair Action
Circuit Boards	Loose, broken, or corroded solder connections. Burned circuit boards. Burned, broken, or cracked circuit-run plating.	Remove failed module and replace with a fresh module.
Resistors	Burned, cracked, broken, blistered.	Replace failed module and replace with a fresh module.
Solder Connections	Cold solder or rosin joints.	Resolder joint and clean with isopropyl alcohol.
Capacitors	Damaged or leaking cases. Corroded solder on leads or terminals.	Remove damaged module and replace with a fresh module from the factory.
Semiconductors	Loosely inserted in sockets. Distorted pins.	Firmly seat loose semiconductors. Remove devices having distorted pins. Carefully straighten pins (as required to fit the socket), using long-nose pliers, and reinsert firmly. Ensure that straightening action does not crack pins, causing them to break off.
Wiring and Cables	Loose plugs or connectors. Burned, broken, or frayed wiring.	Firmly seat connectors. Repair or replace modules with defective wires or cables.
Chassis	Dents, deformations, and damaged hardware.	Straighten, repair, or replace defective hardware.

Cleaning Procedure—Interior

If, after doing steps 1 and 2, a module is clean upon inspection, skip the remaining steps.

1. Blow off dust with dry, low-pressure, deionized air (approximately 9 psi).
2. Remove any remaining dust with a lint free cloth dampened in a isopropyl alcohol (75% solution) and rinse with a warm deionized water. (A cotton-tipped applicator is useful for cleaning in narrow spaces and on circuit boards.)
3. If steps 1 and 2 do not remove all the dust or dirt, the oscilloscope may be spray washed using a solution of 75% isopropyl alcohol by doing steps 4 through 8.
4. Gain access to the parts to be cleaned by removing easily accessible shields and panels (see "Removal and Replacement Procedure").
5. Spray wash dirty parts with the isopropyl alcohol and wait 60 seconds for the majority of the alcohol to evaporate.
6. Use hot (120°F to 140°F) deionized water to thoroughly rinse them.
7. Dry all parts with low-pressure, deionized air.
8. Dry all components and assemblies in an oven or drying compartment using low-temperature (125°F to 150°F) circulating air.

Lubrication

There is no periodic lubrication required for this oscilloscope.

Removal and Installation Procedures

This subsection contains procedures for removal and installation of all mechanical and electrical modules. Any electrical or mechanical module, assembly, or part listed in Section 10 of this manual is a module.

Preparation — Please Read

WARNING

Before performing this or any other procedure in this manual, read the Operator and Service Safety Summaries found at the beginning of this manual. Also, to prevent possible injury to service personnel or damage to this oscilloscope's components, read Before Servicing and Supplying Operating Power in Section 2, *and* Preventing ESD in this section.

This subsection contains the following :

- This preparatory information that you need to properly perform the procedures that follow.
- List of Equipment required to remove all modules.
- Procedures for removal and reinstallation of the electrical and mechanical modules.
- A disassembly procedure for removal of all the major modules from the oscilloscope at one time and for reassembly of those modules into the oscilloscope. Such a complete disassembly is normally only done when completely cleaning the oscilloscope. (Instructions for doing the actual cleaning are found under *Inspection and Cleaning* at the beginning of this section.)
- Three module locator diagrams for finding all the modules in this oscilloscope.

WARNING

Before performing any procedure in this subsection, disconnect the power cord from the line voltage source. Failure to do so could cause serious injury or death.

List of Modules

Section 10 lists all modules.

General Instructions

READ THESE GENERAL INSTRUCTIONS BEFORE REMOVING A MODULE.

First read over the *Summary of Procedures* that follows to understand how the procedures are grouped. Then read *Equipment Required* for a list of the tools needed to remove and install modules in this oscilloscope.

If you are disassembling this oscilloscope for cleaning, go to the procedure *Disassembly for Cleaning* on page 6-47.

If you are removing a module for service, begin by doing the procedure *Access Procedure* (page 6-15). By following the instructions in that procedure, you remove the module to be serviced while removing the minimum number of additional modules.

Summary of Procedures

The procedures are described in the order in which they appear in this section. In addition, you can look up any procedure for removal and reinstallation of any module in the *Table of Contents* of this manual.

- The *Access Procedure* on page 6-15 first directs you to any procedure(s) (if any) that are required to access the module to be serviced, then it directs you to the procedure to remove that module.
- *Procedures for External Modules* on page 6-15 are procedures for removing modules the removal of which do not require internal access to the oscilloscope.
- *Procedures for Outer-Chassis Modules* on page 6-28 are procedures for removing modules the removal of which require access internal to the instrument but external to the chassis.
- *Procedures for Inner-Chassis Modules* on page 6-39 are procedures for removing modules the removal of which require access internal to the instrument and internal to the chassis.
- *Disassembly for Cleaning* on page 6-35 is a procedure, based on the removal procedures just described, that removes all modules for cleaning. Instructions for cleaning are found in *Inspection and Cleaning*, which begins this section.

NOTE

Read the cleaning procedure before disassembling the oscilloscope for cleaning.

Equipment Required – Most modules in this oscilloscope can be removed with a screwdriver handle mounted with a size T-15, Torx® screwdriver tip. *Use this tool whenever a procedure step instructs you to remove or install a screw unless a different size screwdriver is specified in that step.* All equipment required to remove and reinstall each module is listed in the first step of its procedure.

Table 6-4: Tools Required for Module Removal

Item No.	Name	Description	Tektronix Part Number
1	Screwdriver handle	Accepts Torx®-driver bits	003-0301-00
2	T-15 Torx tip	Torx®-driver bit for T-15 size screw heads	003-0966-00
3	T-20 Torx tip	Torx®-driver bit for T-20 size screw heads	003-0866-00
4	T-20 Torx tip	Special Tool: Narrow Torx®-driver bit for T-20 size screw heads (Fan removal only)	003-0866-00
5	Flat-bladed screwdriver	Screwdriver for removing standard-headed screws	
6	Needle-Nose Pliers	Standard tool	
7	Retaining Ring Pliers	Standard tool; 1 1/8 inch minimum throw	
8	Angle-Tip Tweezers	Standard tool	
9	Pliers	Standard tool	

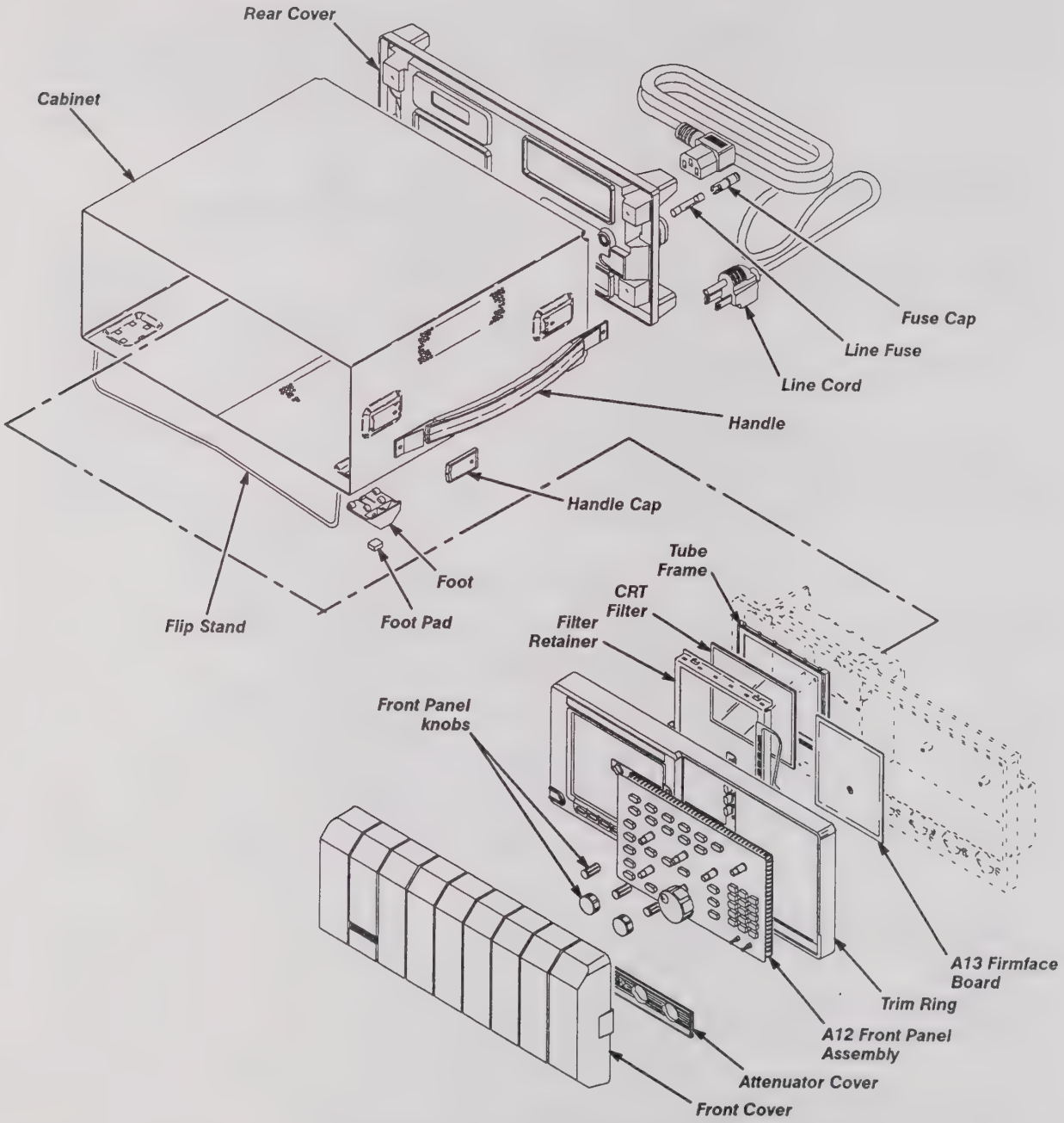


Figure 6-1: External Modules

AUX 1

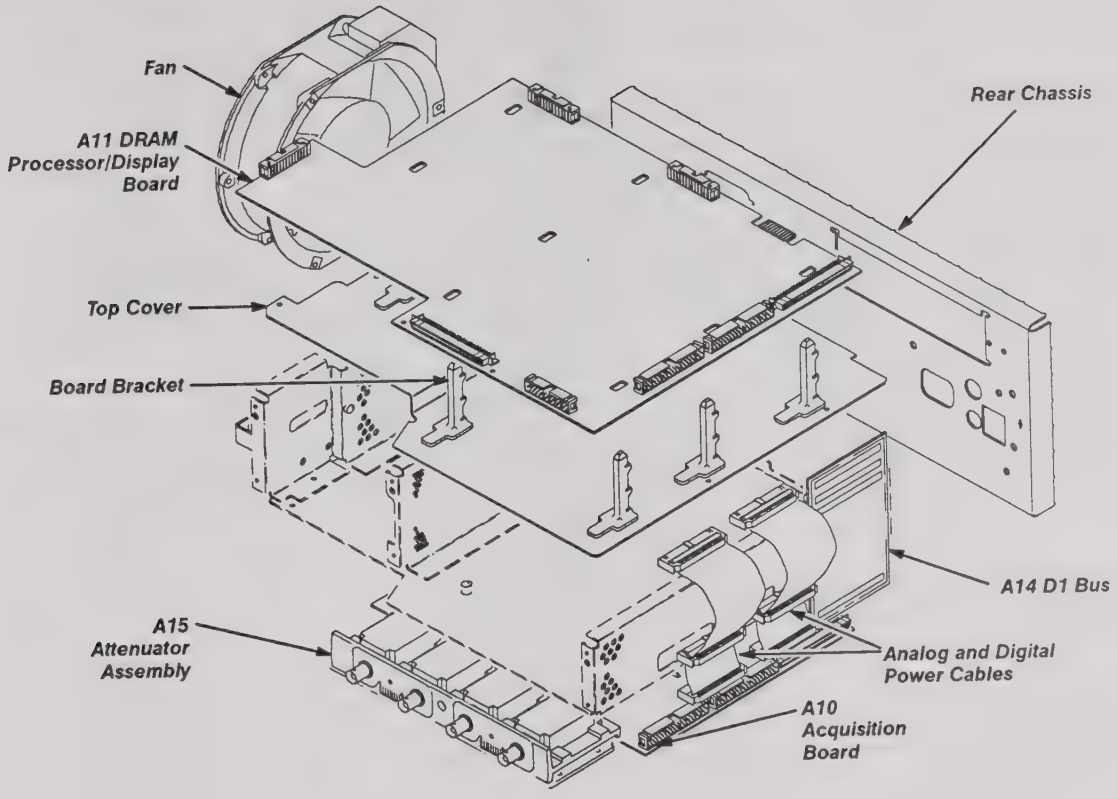


Figure 6-2: *Outer-Chassis Modules*

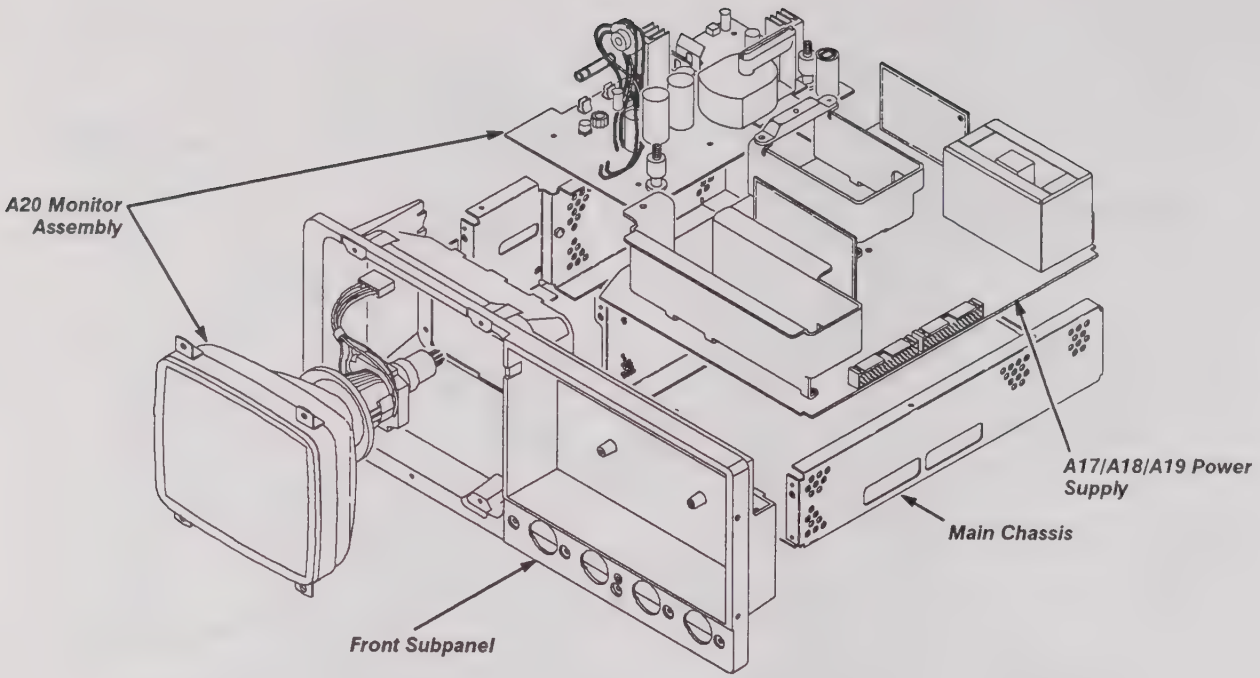


Figure 6-3: Inner-Chassis Modules

Access Procedure

Begin with this procedure when you have identified an module to be removed for service and have read *General Instructions* found earlier in this section.

1. *Locate module to be removed:* Find the module to be removed in the module locator diagrams, Figures 6-1 through 6-3 . Once the module is found, note from the title of the figure whether the module is an external, outer-chassis mounted, or inner-chassis mounted part.

2. *If the module is externally mounted, no internal access is required; remove the module:* Find and perform the procedure whose title matches the name of the module to be removed under *Procedures for External Modules* (page 6-16).

3. *If the module is an outer- or inner-chassis module, access the inside of the instrument:* First do the procedure *Line Fuse and Line Cord,* then do the procedure *Rear Cover and Cabinet.* Both are found under *Procedures for External Modules* immediately following this procedure. After completing those procedures, return to this procedure and continue with step 4.

4. *If the module is an outer-chassis module, remove it:*

   a. If removing the attenuator or display-frame assembly, first do the procedure *A12 Front Cover, Trim Ring, Menu Buttons, and Attenuator Panel,* found under *Procedures for External Modules* (page 6-16).

   b. If removing the display-frame assembly, also do the procedure *A12 Front-panel Assembly and A13 Firmware Board* , found under *Procedures for External Modules* (page 6-16). Do *not* remove the firmware board.

   c. Find and perform the procedure whose title matches the name of the module to be removed under *Procedures for Outer-Chassis Modules* , on page 6-28.

5. *If the module is an inner-chassis module, access the inner-chassis:*

   a. If removing the monitor, high-voltage supply board or its supply fuse, or the front subpanel, first do the procedure *A12 Front Cover, Trim Ring, Menu Buttons, and Attenuator Panel,* found under *Procedures for External Modules.* Also, if removing the front subpanel, do *A12 Front-panel Assembly and A13 Firmware Board* and *A15 Attenuator Assembly,* also found under *Procedures for External Modules.*

   b. If removing the monitor assembly, also remove the display-frame assembly found under *Procedures for Outer-Chassis Modules* , on page 6-28.

   c. Do, in order listed, the three procedures *A14 D1 Bus and Analog-Power and Digital-Power Cables*, *A11 Processor/Display Board* and *Top Cover* found under *Procedures for Outer-Chassis Modules* , page 6-28.

   d. Find and perform the procedure whose title matches the name of the module to be removed under *Procedures for Inner-Chassis Modules*, page 6-39.

6. *Reinstall all modules removed:* Read the instructions found at the end of the procedure that removes the module to be serviced – they will guide you in reinstalling all modules removed.

Procedures for External Modules

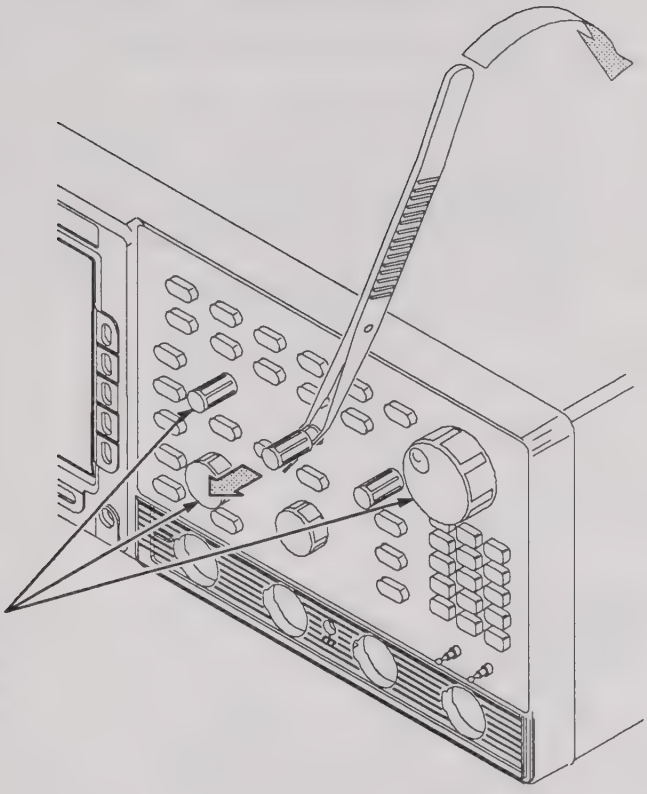
You should have performed the *Access Procedure* (page 6-15) before doing any procedure in this collection.

The following procedures are found here and are listed in order presented.

- *Front-Panel Knobs*
- *Line Fuse and Line Cord*
- *Rear Cover and Cabinet*
- *A12 Front Cover, Trim Ring, Menu Buttons, and Attenuator Panel*
- *A12 Front-panel Assembly and A13 Firmware Board*
- *Cabinet Modules*.

Front-Panel Knobs

1. *Assemble equipment and locate modules to be removed:* Have handy a angled-tip tweezers (Item 8). Find the knob(s) to be removed on the front panel.
2. *Orient the oscilloscope:* Set the oscilloscope so its bottom is down on the work surface and its front is facing you.
3. *Remove the knob(s):* Grasp any knob you wish to remove and pull it straight out from the front panel slightly to create some clearance between the base of the knob and the front panel. Insert the tweezers between the knob and front panel and use them to remove the knob.
4. *Reinstallation:*To reinstall, align knob to shaft and push it in until it snaps.



When reinstalling the knobs, note there are three sizes. Be sure to reinstall the proper size knob in the proper location.

Figure 6-4: Knob Removal

Line Fuse and Line Cord

1. *Assemble equipment and locate modules to be removed:* Have handy a flat-bladed screwdriver (Item 5). Locate the line fuse and line cord in the locator diagram *External Modules*, Figure 6-1.
2. *Orient the oscilloscope:* Set the oscilloscope so its bottom is down on the work surface and its rear is facing you. If you are servicing the line fuse, perform the next step; if you are servicing the line cord, skip to step 4.

3. *Remove line fuse:* Find the fuse cap on the rear panel. (See Figure 6-5.) Now, remove the fuse cap by turning it counter clockwise using a flat-bladed screwdriver, and remove the line fuse. Reverse procedure to reinstall.

4. *Remove line cord:* Find the line cord on the rear cover. (See Figure 6-5) Now, remove the line-cord retaining clamp by first unplugging the line cord from its receptacle. Next, grasp both the line cord and the retaining clamp and rotate it 90 degrees counter-clockwise. Pull the line cord and clamp away to complete the removal. Reverse procedure to reinstall.

5. *Reinstallation:* Perform in reverse steps 3 and 4 to reinstall the line cord and then the line fuse.

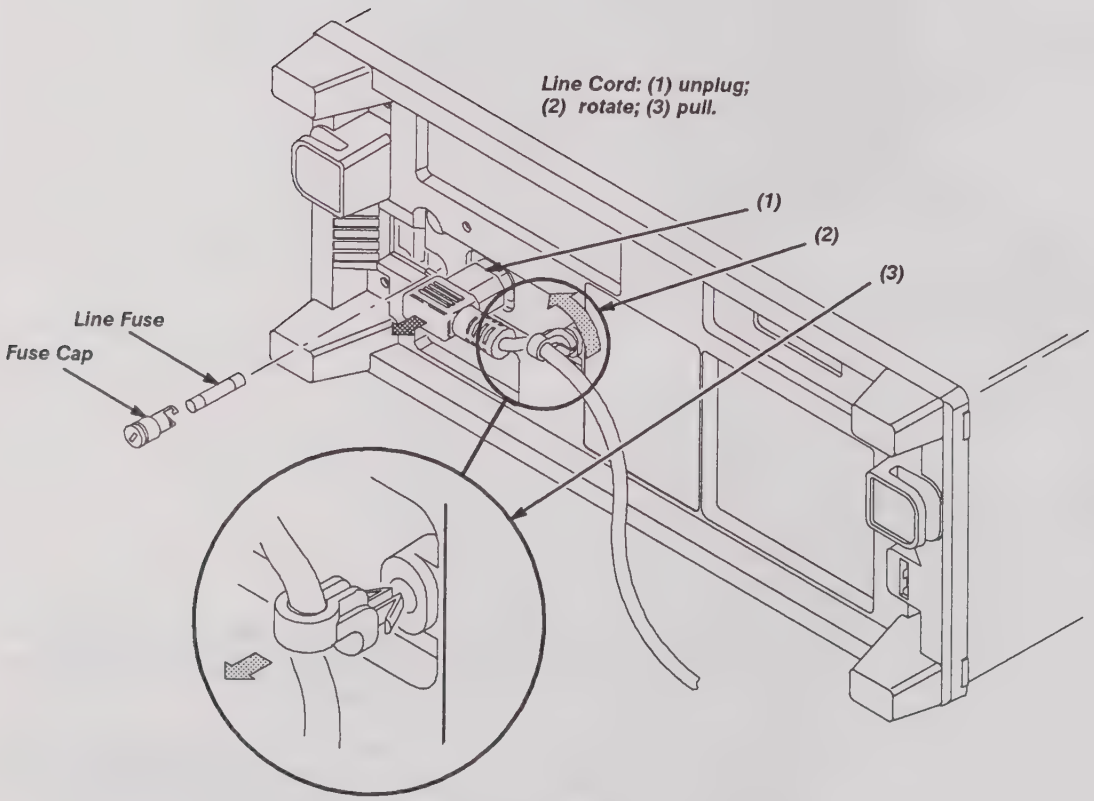


Figure 6-5: Line Fuse and Line Cord Removal

Rear Cover and Cabinet

Additional Modules Removed: Line cord.

1. *Assemble equipment and locate modules to be removed:*
   a. Have handy a screwdriver with a size T-20 Torx® tip (Items 1 and 3.)
   b. Make sure the oscilloscope's front cover is installed; if it's not, install it by snapping its edges over the trim ring.
   c. Locate the rear cover and cabinet in the locator diagram *External Modules*, Figure 6-1.
2. *Orient the oscilloscope:* Set the oscilloscope so its face is down with its front cover on the work surface and its bottom facing you.
3. *Disconnect the line cord:* Unplug the line cord from its receptacle at the rear cover.
4. *Remove rear cover:* Remove the four screws securing the rear cover to the oscilloscope. Lift off the rear cover.
5. *Remove the cabinet:* At the rear of the cabinet, grasp its left and right edges. Pull upward to slide the cabinet off the oscilloscope. Take care not to bind or snag the cabinet on the oscilloscope's internal cabling as you remove it.
6. *Reinstallation:* Perform in reverse order steps 3 and 4 to reinstall the cabinet. Take care not to bind or snag the cabinet on internal cabling; redress cables an necessary. See the procedure *Line Fuse and Line Cord* to reinstall the line cord, which completes the oscilloscope reassembly.

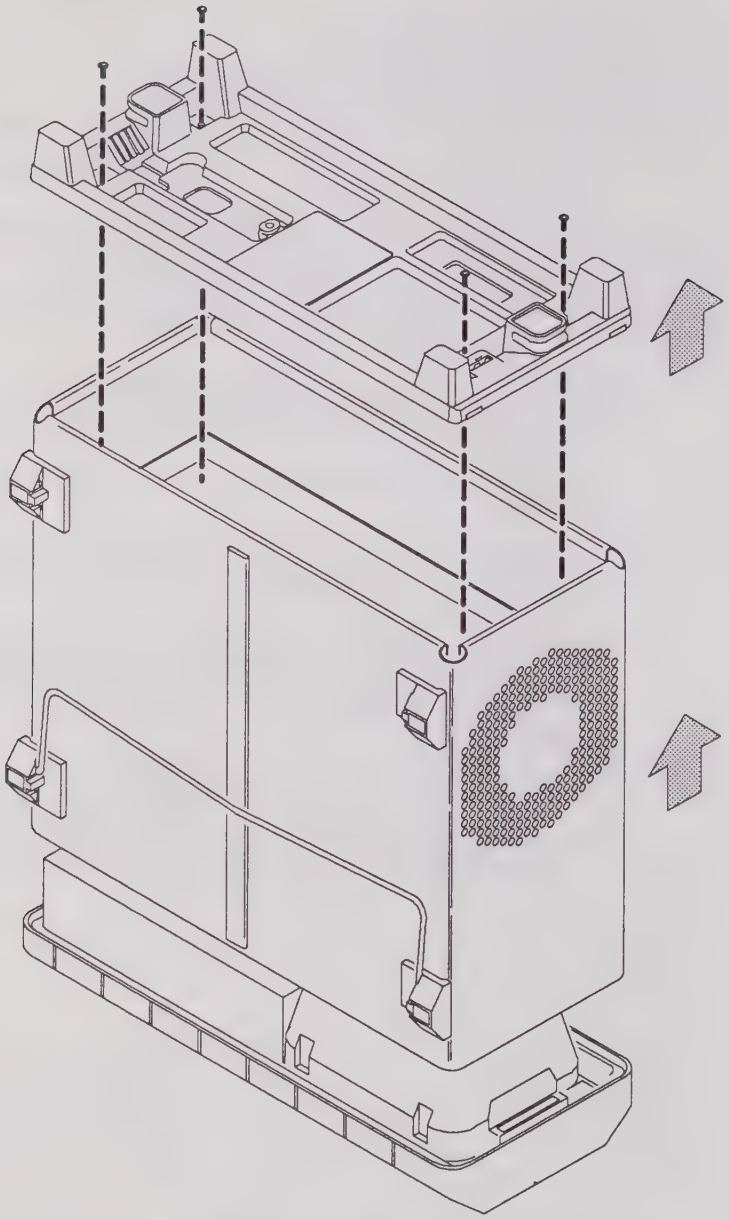


Figure 6-6: Rear Cover and Cabinet Removal

A12 Front Cover, Trim Ring, Menu Buttons, and Attenuator Panel

1. *Assemble equipment and locate modules to be removed:* No tools are needed. Locate the modules to be removed in the locator diagram *External Modules*, Figure 6-1.
2. *Orient the oscilloscope:* Set the oscilloscope so its rear is down on the work surface and its bottom is facing you.
3. *Remove the front cover:* Grasp the front cover by its left and right edges and snap it off of the front subpanel. (When reinstalling, align and snap back on.)

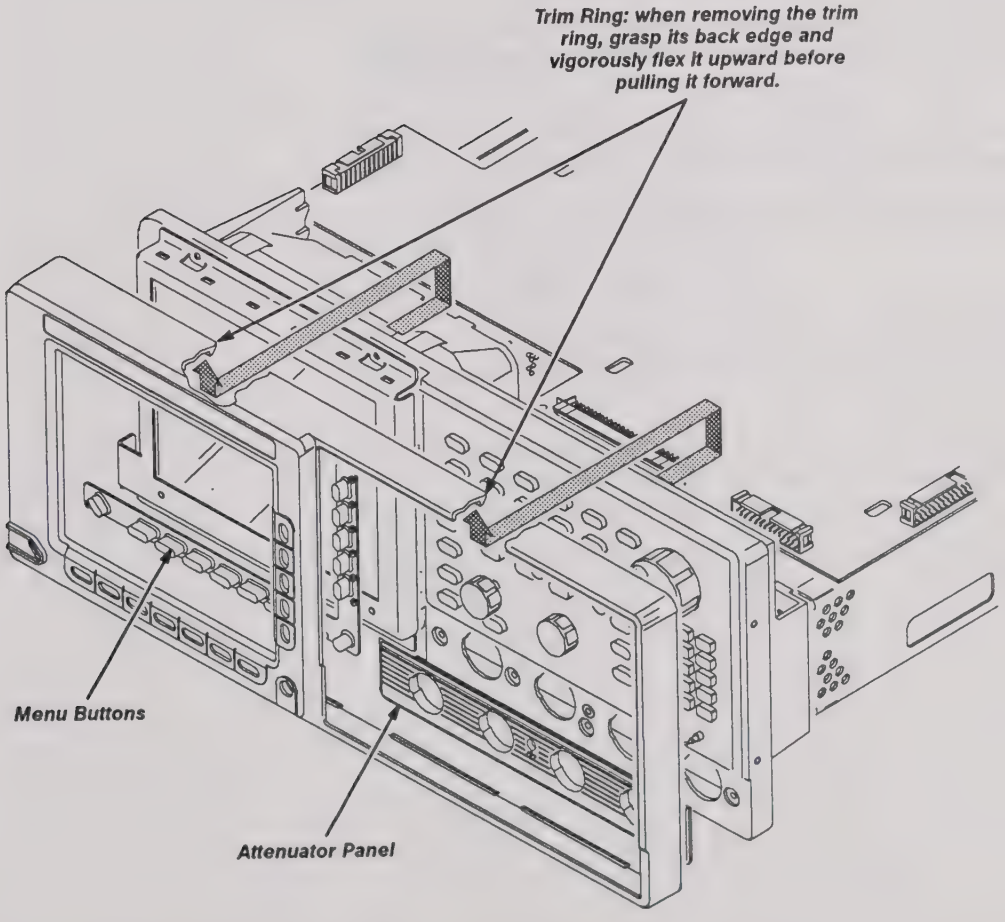

Trim Ring: when removing the trim ring, grasp its back edge and vigorously flex it upward before pulling it forward.
Menu Buttons
Attenuator Panel

Figure 6-7: Front Cover, Trim Ring, Menu Buttons, and Attenuator Panel Removal (Front Cover not Shown.)

DO NOT touch the carbon contact points on the menu buttons installed in the trim ring. Also, do not touch the contacts on the flex circuit exposed when you remove the trim ring.

4. *Remove the trim ring:* Grasp the trim ring by its top edge and pry it up and lift it forward to snap it off of the front subpanel. If servicing the menu buttons, lift them out of the trim ring. (When reinstalling, reinsert the menu buttons, align the trim ring to the front subpanel and press it back on.)
5. *Remove the attenuator panel:* Gently pry, using your fingers, the snap-off/snap-on attenuator panel away from the front subpanel to remove it. (When reinstalling, use your hands to press it back on.)
6. *Reinstallation:* Perform in reverse steps 3–5 to reinstall the attenuator panel, menu buttons, trim ring, and the front cover, following the reinstallation instructions found in each step.

A12 Front-panel Assembly and A13 Firmware Board

NOTE

This procedure includes removal and reinstallation instructions for the front panel and front panel buttons. Unless either of those modules are being serviced, do not perform step 4, "Further disassembly of front-panel assembly."

Additional Modules Removed: The front cover and trim ring.

1. *Assemble equipment and locate modules to be removed :*
   a. Have handy a screwdriver with a size T-15 Torx® tip (Items 1 and 2).
   b. Locate the modules to be removed, including those listed under *Additional Modules Removed* in the locator diagram *External Modules*, Figure 6-1.
   c. Perform the procedure *A12 Front Cover, Trim Ring, Menu Buttons, and Attenuator Panel,* steps 1–3, immediately preceding this procedure.
2. *Orient the oscilloscope:* Set the oscilloscope so its bottom is down on the work surface and its front is facing you.
3. *Remove the front-panel assembly:*
   a. Lift the front-panel assembly out of the front subpanel until you can reach the interconnect cable connecting it to the processor/display board.
   b. Disconnect that cable at J2 of the processor/display board. Disconnect the flex-board connector at P3 of the front-panel assembly. (The flex board is part of the display-frame assembly.)
   c. Finally, lift the front-panel assembly out of the front subpanel to complete the removal.

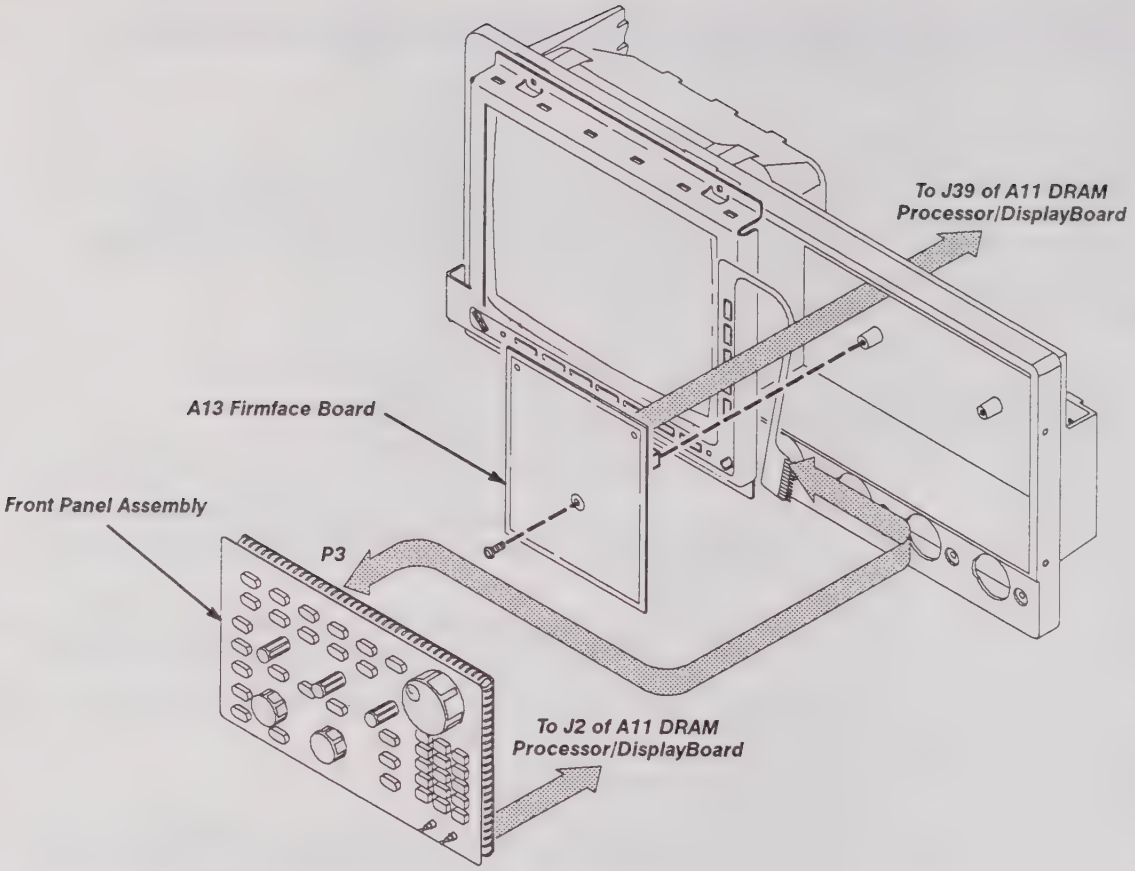


Figure 6-8: A12 Front-Panel Assembly and A13 Firmface Board Removal

4. *Further disassembly of front-panel assembly:* If the front panel or the front-panel buttons are to be serviced, do the following substeps:

   a. Remove the front-panel control knobs from the front-panel assembly using the method described in *Front-Panel Knobs* on page 6-16.

   b. Remove the eight screws mounting the front-panel board to the front panel.

   c. Now hand disassemble the front-panel-assembly components using Figure 6-9 as a guide. Reverse procedure to reassemble, using the same Figure 6-9 as a guide.

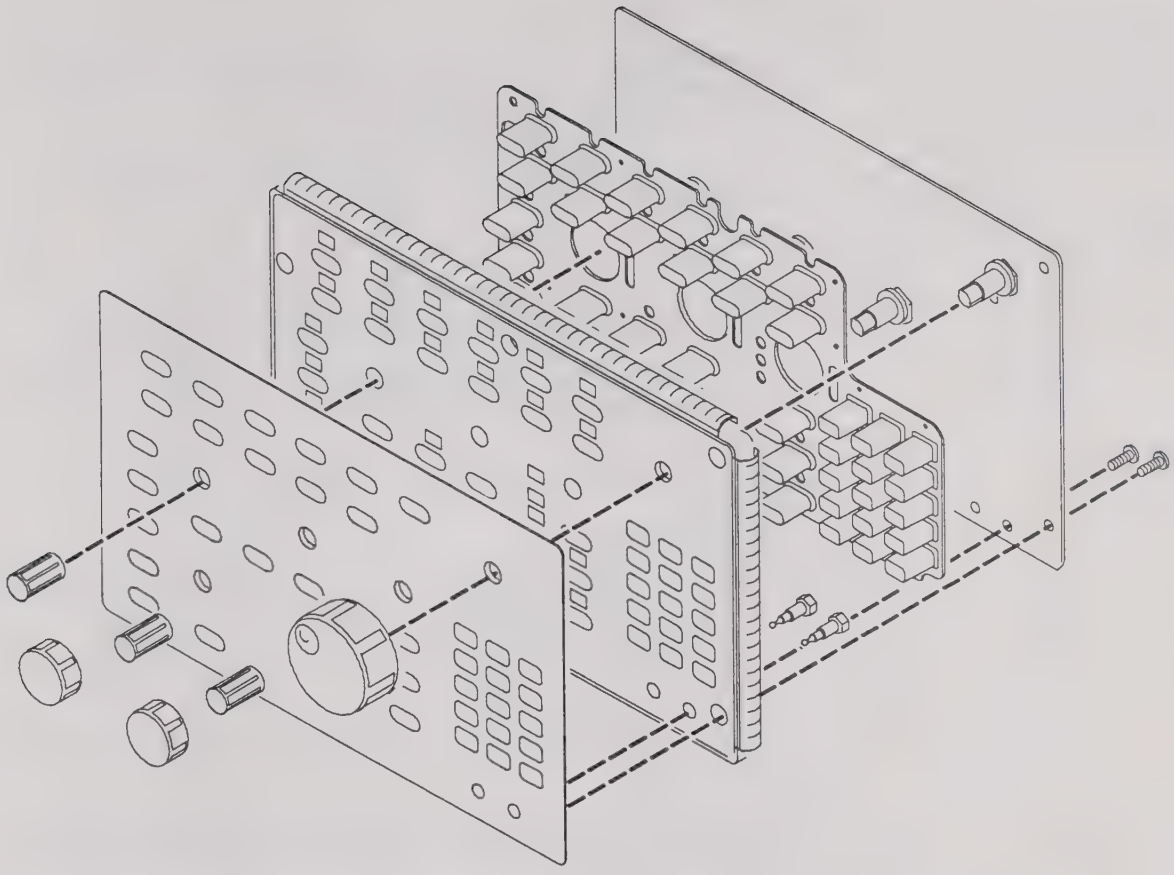


Figure 6-9: Disassembly of Front-Panel Assembly

5. *Remove the firmware board:* Remove the three screws that secure the firmware board to the front subpanel. Now, grasp the firmware board and lift it straight out, disconnecting it from the processor/display board at J39, which is connected to J2 of the firmware board. (See Figure 6-8 on page 6-24.)

6. *Reinstallation:* If the front-panel assembly was further disassembled in step 4, then reverse substeps 4a–4c to reassemble, using figure as a guide.Then perform in reverse order steps 3 and 5, reversing the procedure outlined in each step. Last, reinstall the trim ring and, if desired, the front cover, referring to the procedure *A12 Front Cover, Trim Ring, Menu Buttons, and Attenuator Panel* (page 6-21).

Cabinet Modules

1. *Assemble equipment and locate modules to be removed:* Have handy a pair of needle-nose pliers (Item 6). Locate the modules to be removed in the locator diagram *External Modules*.
2. *Orient the oscilloscope:* Set the oscilloscope so left side is down on the work surface and its handle is facing upwards.
3. *Remove the handle:*
   a. Insert the tips of a pair on needle-nose pliers (Item 6) into the hole of either handle cap. Push and hold to depress the handle release.
   b. While holding the handle released, pull it out of the slot in the handle cap. Repeat procedure to remove the handle from the other handle cap.
   c. Reverse procedure to reinstall.
4. *Remove the handle caps:*
   a. Insert the retaining ring pliers (Item 7) into the opening created in the handle cap when you removed the handle.
   b. While using the pliers to expand the handle cap outward, grasp it and snap it off.
   c. Repeat procedure to remove the remaining cap as needed; push the cap(s) back on to reinstall.
5. *Remove the bail:* Grasp the bail by both sides near where it joins each bail cap. Now compress the bail until the bail ends clear the bail caps to complete the removal.
6. *Remove the bail cap(s):*
   a. Perform *Rear Cover and Cabinet* (page 6-19) to gain access to inside of the cabinet.
   b. Working from inside the cabinet, push the two retainers to release the bail cap you wish to remove and lift it away from the outside of the cabinet.
   c. Repeat procedure to remove as many of the remaining caps as needed; insert the two retainers back in their slots in the cabinet and snap into place any bail cap removed.
7. *Reinstallation:* If any bail caps were removed, reinstall as directed in step 6c, then see *Rear Cover and Cabinet* (page 6-19) to reinstall the rear cover and cabinet. Perform in reverse order steps 3 and 5, reversing each step, to reinstall the bail, then the handle caps (if removed), then the handle.

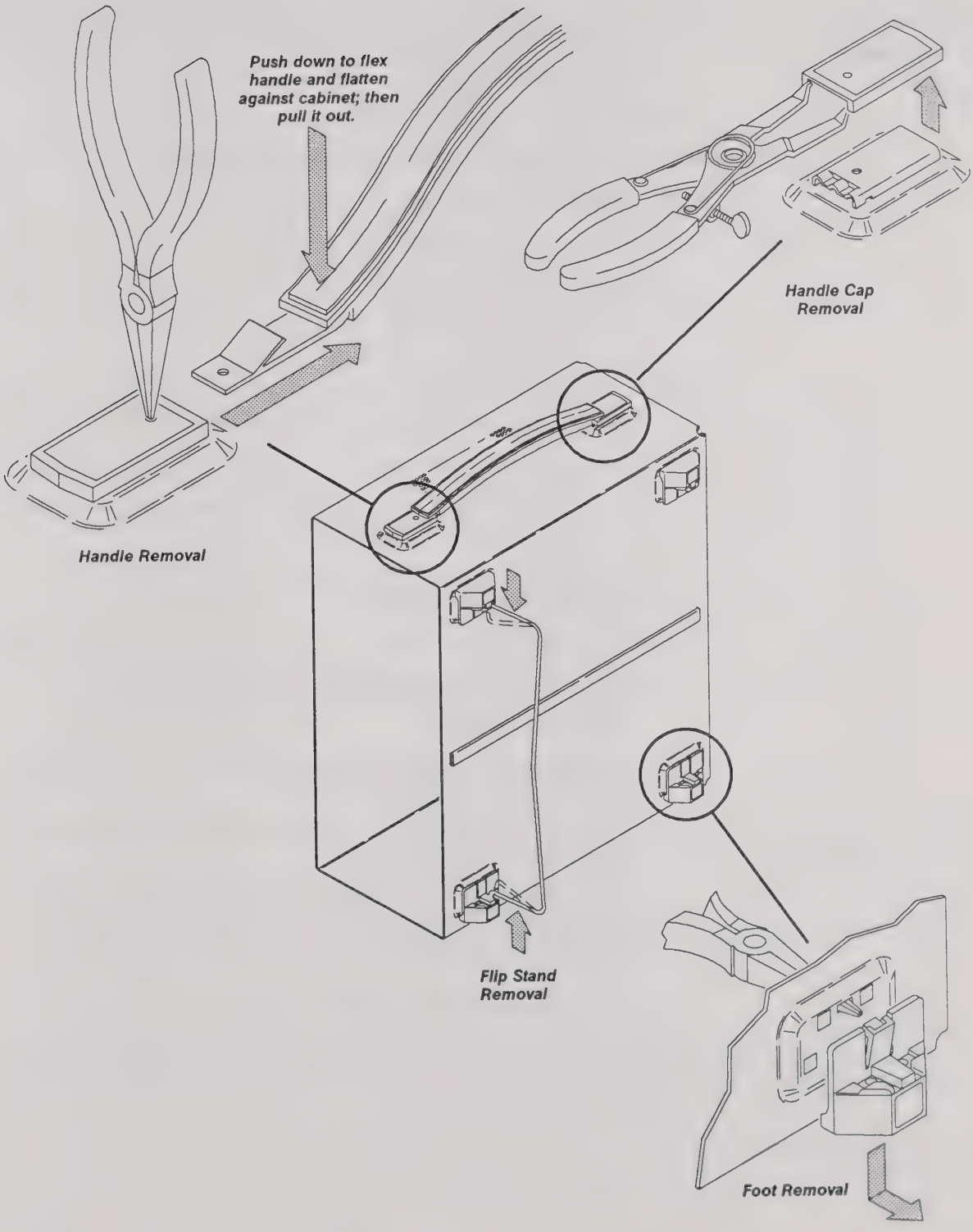

Push down to flex handle and flatten against cabinet; then pull it out.
Handle Removal
Handle Cap Removal
Flip Stand Removal
Foot Removal

Figure 6-10: Cabinet Modules Removal

Procedures for Outer-Chassis Modules

You should have performed the *Access Procedure* before doing any procedure in this collection. The procedures found here, listed in order presented, follow.

- *A15 Attenuator Assembly*
- *, Fan*
- *A14 D1 Bus and Analog-Power and Digital-Power Cables*
- *A11 Processor/Display Board*
- *Top Cover and Board Brackets*
- *A9Acquisition Board*
- *Rear Chassis*

A15 Attenuator Assembly

1. *Assemble equipment and locate modules to be removed:*
   a. Have handy a screwdriver with a size T-15 Torx® tip (Items 1 and 2).
   b. Locate the modules to be removed in the locator diagram *Outer-Chassis Modules*, Figure 6-2, page 6-13.
2. *Orient the oscilloscope:* Set the oscilloscope so its top is down on the work surface and its front is facing you.
3. *Remove the Attenuator Assembly:*
   a. Unplug each of the four interconnect cables that connect the attenuators to the Acquisition board from its jack on the Acquisition board. See Figure 6-29.
   b. Unplug the ribbon interconnect cable that plugs in from the attenuator at J1153. See Figure 6-29.
   c. Now, remove the four screws the heads of which you exposed when you removed the attenuator panel.
   d. Complete the removal by lifting the attenuator assembly out of the front subpanel. Reverse the procedure to reinstall. Be careful to plug each cable into its correct jack — Figure 6-29 shows the correct orientation.
4. *Reinstallation:* Perform in reverse order substeps 3a–3d, reversing the removal instructions in each substep to reinstall the assembly. See the procedures *A12 Front Cover, Trim Ring, Menu Buttons, and Attenuator Panel* (page 6-21) and *Rear Cover and Cabinet* (page 6-19) to complete reassembly of the oscilloscope.

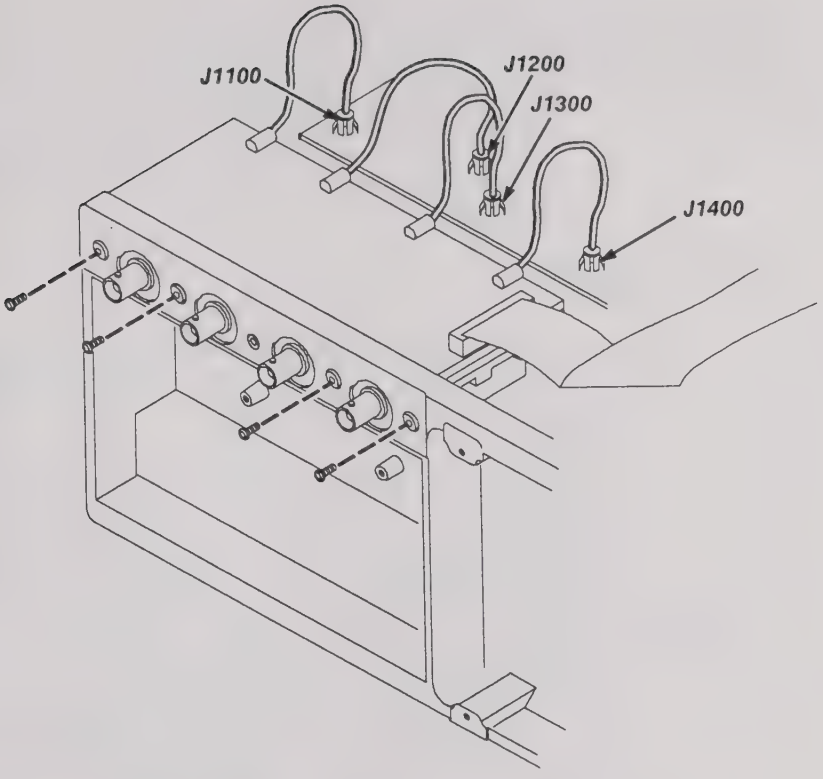


Figure 6-11: Attenuator Interconnect Cable Routing and Jack Locations

Display-Frame Assembly

1. *Assemble equipment and locate modules to be removed:* Have handy a screwdriver with a size T-15 Torx® (Items 1 and 2). Locate the modules to be removed in the locator diagram *Outer-Chassis Modules*, Figure 6-2, page 6-13.
2. *Orient the oscilloscope:* Set the oscilloscope so its bottom is down on the work surface and its front is facing you.
3. *Remove the display-frame assembly:*
   a. Lift the front-panel assembly out of the front subpanel until you can reach J2 on the front-panel assembly. Disconnect the flex cable coming from the display-frame assembly at J39 of the front-panel assembly.
   b. Remove the three screws securing the display-frame assembly to the front subpanel and remove that assembly.

4. *Reinstallation:*

   a. Perform, in reverse order, substeps 3a–3b, reversing each step to reinstall the display-frame assembly.

   b. See the procedure see *A12 Front Cover, Trim Ring, Menu Buttons, and Attenuator Panel* (page 6-21), then *Rear Cover and Cabinet* (page 6-19) to reinstall those modules and complete the reassembly of the oscilloscope.

Fan

1. *Assemble equipment and locate modules to be removed:* Have handy a screwdriver with a size T-20 Torx® tip (Items 1 and 3). Locate the modules to be removed in the locator diagram *Outer-Chassis Modules*, Figure 6-2, page 6-13.
2. *Orient the oscilloscope:* Set the oscilloscope so its bottom is down on the work surface and its left side is facing you.
3. *Disconnect the fan from processor/display board:* Unplug the fan's power cable from J20.
4. *Remove the fan:* Remove the two screws securing the fan to the main chassis and lift the fan away from the chassis.
5. *Reinstallation:* Perform in reverse order substeps 3 and 4, reversing the removal instructions in each substep to reinstall the assembly. See the procedure *Rear Cover and Cabinet* (page 6-19) to complete reassembly of the oscilloscope.

A14 D1 Bus and Analog-Power and Digital-Power Cables

1. *Assemble equipment and locate modules to be removed:* Have handy a screwdriver with a size T-15 Torx® tip (Items 1 and 2). Find the modules to be removed in the locator diagram *Outer-Chassis Modules*, Figure 6-2, page 6-13.
2. *Orient the oscilloscope:* Set the oscilloscope so its left side is down on the work surface and its front is facing you.
3. *Remove the D1 bus:* Grasp the D1 bus and pull it up from the oscilloscope to unplug it from its two plug-in connectors. (J28 is the connector on the processor/display board; J100 is on the acquisition board.) Reverse these removal instructions to reinstall.
4. *Remove the analog-power and digital-power interconnect cables:* Unplug the analog-power cable from the connector at J26 on the display processor board; then from J5 on the low-voltage power supply. Finally, unplug it from J700 on the acquisition board to complete the removal. Now, unplug the digital-power cable at J27 on the display processor board, at J6 on the low-voltage power supply, and at J101 on the acquisition board.

5. *Reinstallation:* Perform in reverse order steps 3 and 4, reversing the procedure outlined in each step to reinstall the assembly. See the procedure *A12 Front Cover, Trim Ring, Menu Buttons, and Attenuator Panel* (page 6-21) and *Rear Cover and Cabinet* (page 6-19) to complete reassembly of the oscilloscope.

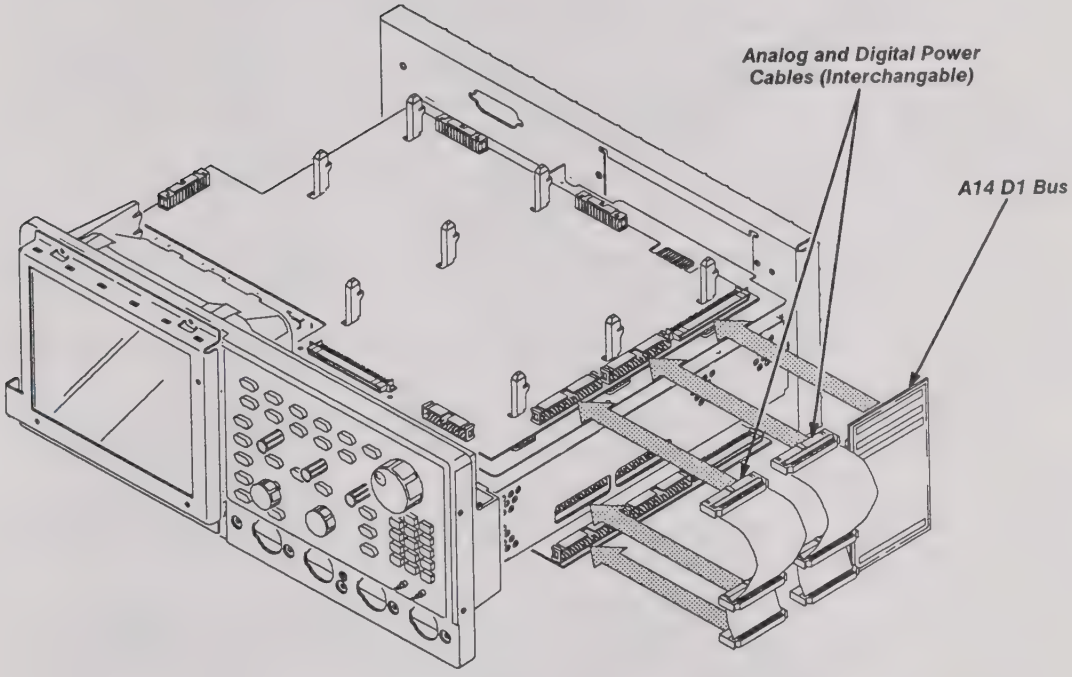


Figure 6-12: A14 D1 Bus and Analog-Power and Digital-Power Cables Removal

A11 Processor/Display Board

Additional modules Removed: D1 bus and analog-and digital-power cables.

1. *Assemble equipment and locate modules to be removed*

   a. Have handy a screwdriver with a size T-20 Torx® tip (Items 1 and 2).

   b. Locate the modules to be removed in the locator diagram *Outer-Chassis Modules*, Figure 6-2, page 6-13.

   c. Perform the procedure *A14 D1 Bus and Analog-Power and Digital-Power Cables* that immediately precedes this procedure to remove those interconnect cables.

2. *Orient the oscilloscope:* Set the oscilloscope so its bottom is down on the work surface and its rear is facing you.

3. *Disconnect the fan from processor/display board:* Unplug the fan's power cable from J20.

4. *Remove the processor/display Board:* Use Figure 6-13 as a guide perform the following substeps:

   a. Working from the rear panel, remove the two screws mounting the support bracket in the rear panel. Then lift it out from the rear panel.

   b. Unplug the interconnect cable from the GPIB connector on the rear cover at J35 of the processor/display board. Disconnect the monitor bus cable at J5.

   c. Grasp the board by its right and left sides and pull it towards the rear of the oscilloscope. This will disconnect the processor/display board from its connection to the firmware board at J39 and, at the same time, release it from the eight board mounts securing the board above the top cover.

   d. Lift the board up away from the oscilloscope chassis to complete the removal.

5. *Reinstallation:* Perform, in reverse order, steps 3 through 5 reversing the removal instructions of each step to reinstall the processor/display board. (Be sure to simultaneously align the firmware board for connection at J39 when remounting the board to the eight board mounts in substep 4c.) See the procedures *A14 D1 Bus and Analog-Power and Digital-Power Cables* and *Rear Cover and Cabinet* (page 6-19) to complete reassembly of the oscilloscope.

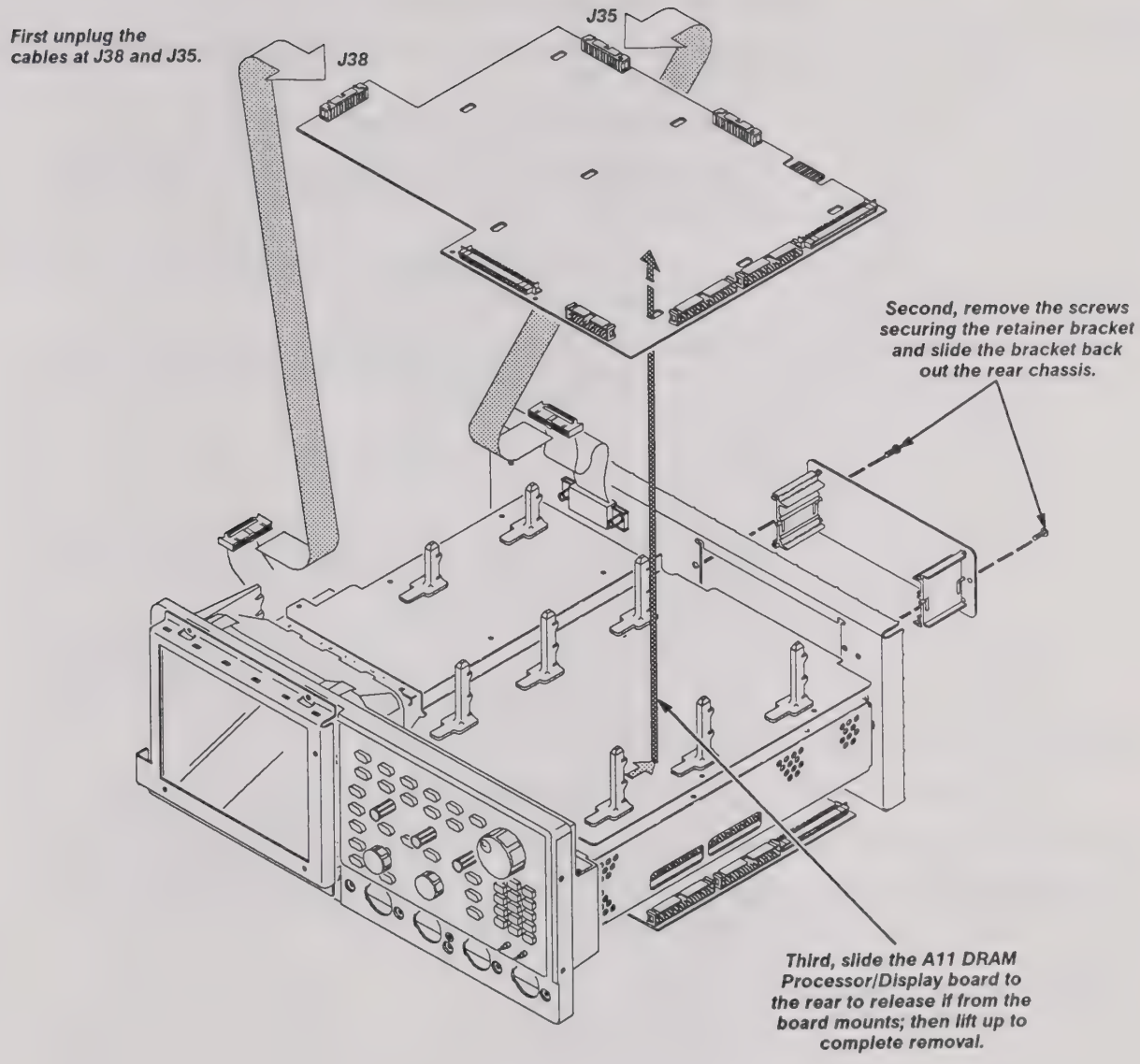

First unplug the cables at J38 and J35.
J38
J35
Second, remove the screws securing the retainer bracket and slide the bracket back out the rear chassis.
Third, slide the A11 DRAM Processor/Display board to the rear to release if from the board mounts; then lift up to complete removal.

Figure 6-13: Processor and Fan Removal

Top Cover and Board Brackets

Additional Modules Removed: D1 bus, analog- and digital-power cables, and processor/display board.

1. *Assemble equipment and locate modules to be removed*

   a. Have handy a screwdriver with a size T-15 Torx® tip (Items 1 and 2) and, if removing any *board mount*, a flat-bladed screwdriver (Item 6-11).

   b. Locate the modules to be removed in the locator diagram *Outer-Chassis Modules*, Figure 6-2, page 6-13.

   c. Perform the procedures *A14 D1 Bus and Analog-Power and Digital-Power Cables* (page 6-30) and *A11 Processor/Display Board* (page 6-32 to remove those modules.

2. *Orient the oscilloscope:* Set the oscilloscope so its bottom is down on the work surface and its front is facing you.

3. *Remove the top cover*: Remove the 12 screws securing the top cover to the main chassis, then slide it back until its front edge clears the retainers in the front subpanel. Lift the top cover away to complete removal.

4. *Remove the board mount(s):* From the top side of the top cover, use the flat-bladed screwdriver to pry up the retainer lug until it clears the slot in the front cover. While holding the lug clear of the slot, push the mount towards the rear until it releases. (When reinstalling, be sure to align the lug properly and be sure it snaps into its slot.)

5. *Reinstallation:* Perform in reverse order steps 3 and 4, reversing the procedure outlined in each step to reinstall the assembly. See the procedures *A11 Processor/Display Board* , *A14 D1 Bus and Analog-Power and Digital-Power Cables*, *A12 Front Cover, Trim Ring, Menu Buttons, and Attenuator Panel* (page 6-21) and *Rear Cover and Cabinet* (page 6-19) to complete reassembly of the oscilloscope.

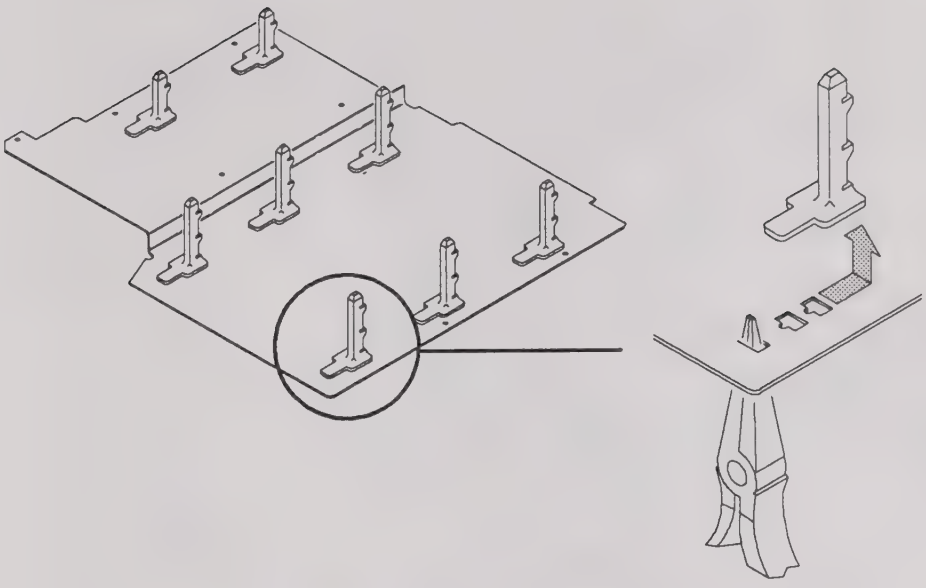


Figure 6-14: *Board Bracket Removal*

A9Acquisition Board

Additional Modules Removed: *D1 bus*, and *analog-* and *digital-power cables*.

1. *Assemble equipment and locate modules to be removed:*
   a. Have handy a screwdriver with a size T-15 Torx® tip (Items 1 and 2).
   b. Locate the modules to be removed, including those listed under *Additional Modules Removed* in the locator diagram *Outer-Chassis Modules*, Figure 6-2, page 6-13.
   c. Perform the procedure *A14 D1 Bus and Analog-Power and Digital-Power Cables* found earlier in this section to remove the D1 bus and the interconnect cables.
2. *Orient the oscilloscope:* Set the oscilloscope so its top is down on the work surface and its front is facing you.
3. *Remove the Acquisition Board*: Use Figure 6-15 as a guide.
   a. Unplug each of the four interconnect cables that connect the attenuators to the acquisition board from its jack on the Acquisition board.
   b. Unplug the ribbon interconnect cable that plugs in from the attenuator at J1153.
   c. Remove the six screws that mount the acquisition board to the main chassis and lift the board away from the main chassis to complete removal.

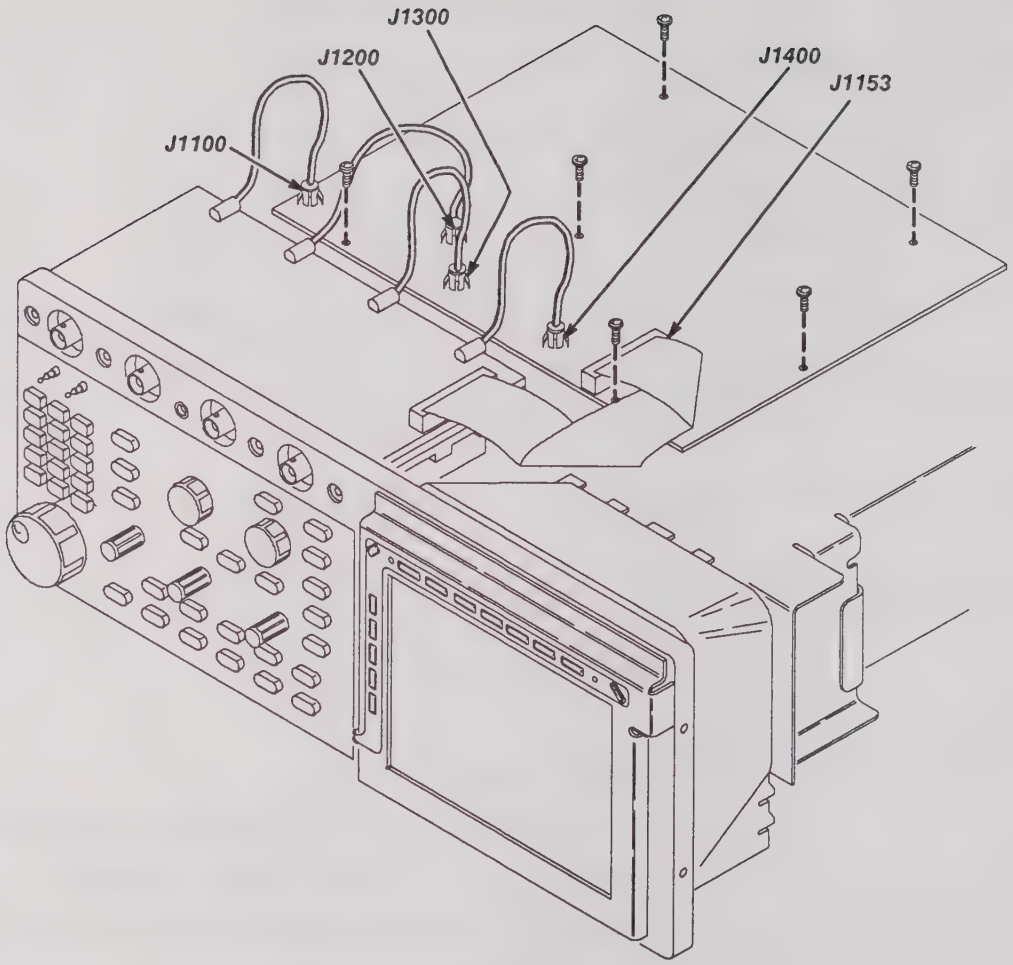


Figure 6-15: Acquisition Board Removal

4. *Reinstallation:* Perform, in reverse order, substeps 3a–3NO TAG reversing each step to reinstall the *acquisition board*. See the procedures and *A14 D1 Bus and Analog-Power and Digital-Power Cables*, *A12 Front Cover, Trim Ring, Menu Buttons, and Attenuator Panel* (page 6-21), and *Rear Cover and Cabinet* (page 6-19) to complete reassembly of the oscilloscope.

Rear Chassis

1. *Assemble equipment and locate modules to be removed:*

   a. Have handy a screwdriver with a size T-15 Torx® tip (Items 1 and 2) and a T-20 Torx® tip (Items 1 and 2).

   b. Locate the modules to be removed, including those listed under *Additional Modules Removed* in the locator diagram *Outer-Chassis Modules*, Figure 6-2, page 6-13.

c. Install the front cover if it's not already installed.

2. *Orient the oscilloscope:* Set the oscilloscope so its bottom is down on the work surface and its rear is facing you.

3. *Remove the rear chassis.* Use Figure 6-16 as a guide when performing the following substeps:

   a. Unplug the GPIB interconnect cable at J32 of the processor/display board.

   b. Remove the 6 screws securing the rear chassis to the main chassis and the two screws securing it to the low-voltage power-supply shield.

4. *Reinstallation:* Perform, in reverse order, substeps 3a–3b, reversing each step to reinstall the rear chassis. See the procedure *A14 D1 Bus and Analog-Power and Digital-Power Cables* and *Rear Cover and Cabinet* (page 6-19) reinstall those modules.

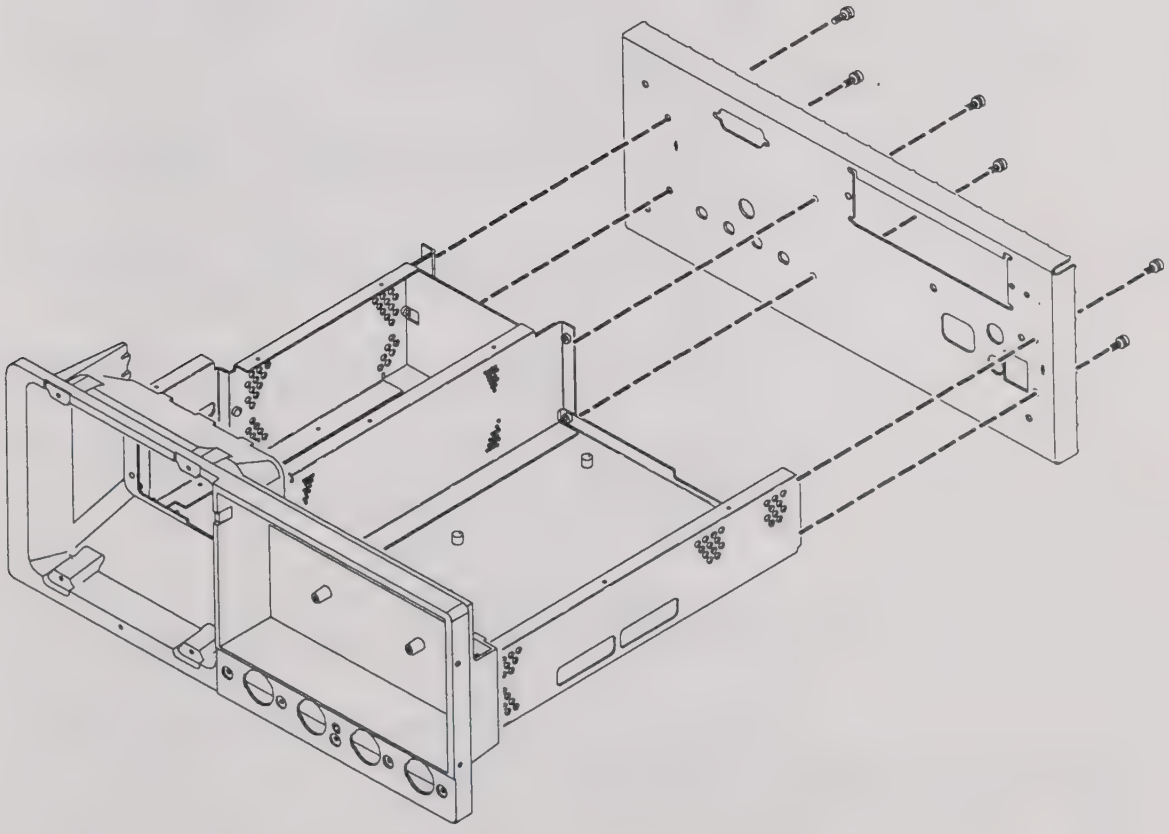


Figure 6-16: Rear Chassis Removal

Procedures for Inner-Chassis Modules

You should have performed the *Access Procedure* (page 6-15) before doing any procedure in this collection. The procedures found here, listed in order presented, follow.

A16 Power Supply

A20 Display Assembly and Supply Fuse

Front Subpanel

Main Chassis.

A16 Power Supply

1. *Assemble equipment and locate modules to be removed:* Have handy a screwdriver with a size T-15 Torx® tip (Items 1 and 2). Locate the modules to be removed in the locator diagram *Inner-Chassis Modules*, Figure 6-2, page 6-13.
2. *Orient the oscilloscope:* Set the oscilloscope so its bottom is down on the work surface and its rear is facing you.
3. *Remove the low-voltage power Supply:*
   a. Working from the rear of the oscilloscope, remove the two screws securing the low-voltage power supply to the rear chassis. See Figure 6-17.
   b. Now, working from the top of the oscilloscope, remove the seven screws indicated in Figure 3-6 that mount the supply to the main chassis.
   c. Grasp the supply at the points indicated in the same figure and lift the board up out of the oscilloscope to complete removal.
4. *Reinstallation:* Perform, in reverse order, substeps 3a through 3c reversing each step to reinstall the low-voltage power supply. Then see the following procedures to complete the reassembly:
   a. *Top Cover and Board Brackets.*
   b. *A11 Processor/Display Board.*
   c. *A14 D1 Bus and Analog-Power and Digital-Power Cables* (page 6-30).
   d. *Rear Cover and Cabinet* (page6-19) to complete the reassembly of the oscilloscope.

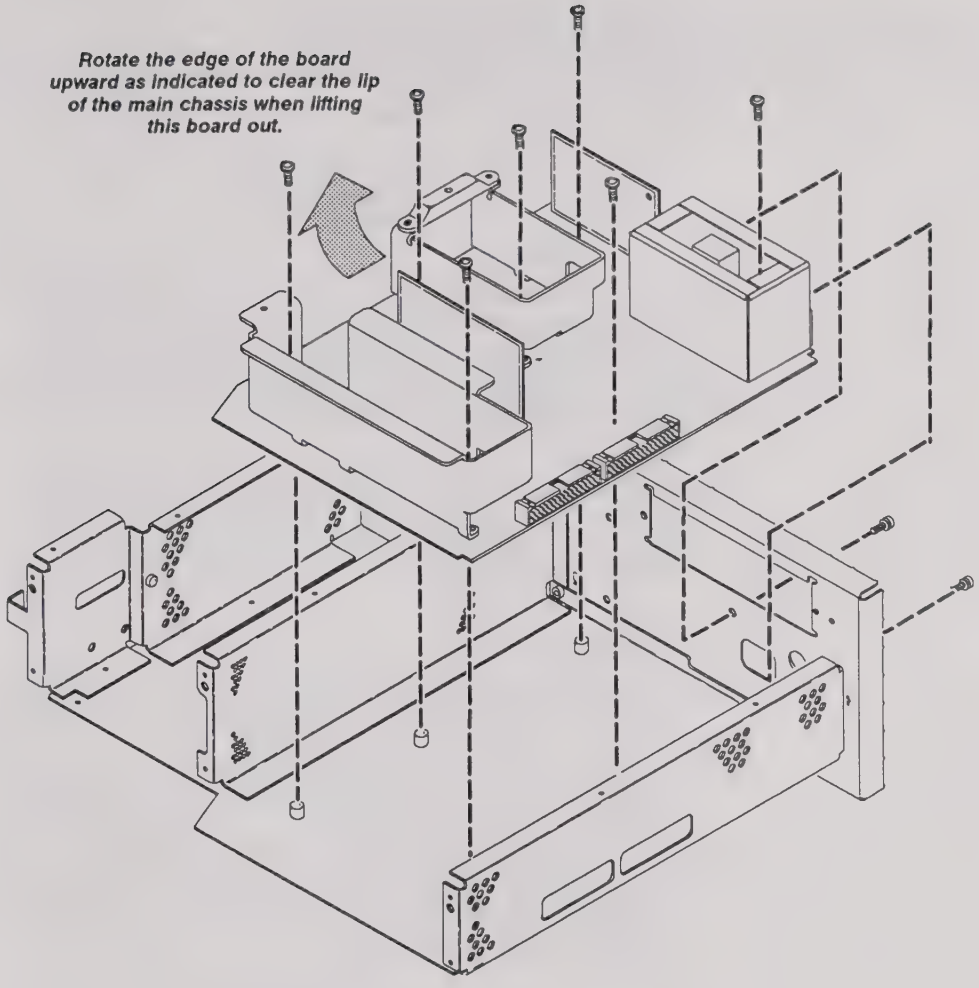


Figure 6-17: A16 Power Supply Removal

A20 Display Assembly and Supply Fuse

NOTE

The monitor and high-voltage supply board are a single module and must be removed and replaced as such. They are listed as a single module in the Replaceable Parts List.

1. *Assemble equipment and locate modules to be removed:* Have handy a screwdriver with a size T-15 Torx® tip (Items 1 and 2). Locate the modules to be removed in the locator diagram *Inner-Chassis Modules*, Figure 6-2, page 6-13.

2. *Orient the oscilloscope:* Set the oscilloscope so its bottom is down on the work surface and its rear is facing you.

3. *Remove the high-voltage fuse:* If you are servicing this fuse, remove the fuse from its fuse holder. Reverse the procedure to reinstall.

WARNING

Monitor handling: Use care when handling a monitor. If you break a monitor it may implode, scattering glass fragments with high velocity and possibly injuring you. Wear protective clothing, including safety glasses (preferably a full-face shield). Avoiding striking the monitor with or against any object.

Monitor Storage: Store the monitor face down in a protected location, placing it on a soft, nonabrasive surface to prevent scratching the face plate.

4. *Remove the monitor:*

   a. Take the precautions outline in the warning above. Reference Figure 6-18 while doing the following substeps.

   b. Unplug the monitor connector from the back of the monitor and the monitor yoke connector from the monitor circuit board (J340).

   c. Remove the two screws that secure the band circling the front of monitor to the front subpanel. Carefully guide the monitor forward to partially remove it from the front subpanel and to access the anode lead connected to the monitor.

WARNING

High-voltage is present on the anode lead. Before unplugging the anode in the following substep , you must discharge it: ground a flat-bladed screwdriver (Item 5) with an insulated handle to the chassis through a suitable grounding strap. Next, probe under the insulating cap of the anode lead and touch the lead's metal conductor to discharge. Repeat. After unplugging the anode in substep d, touch its metal conductor to the chassis for a few minutes to further ensure discharge.

   d. Discharge the anode lead as described in the immediately proceeding ***WARNING,*** unplug it from the monitor, and discharge that lead (again see ***WARNING***).

e. Be sure you have read the ***WARNING*** on monitor handling and storage found at the start of this monitor removal procedure. Then pull the monitor out through the front subpanel to complete removal. Store as directed in the previous ***WARNING*** message.

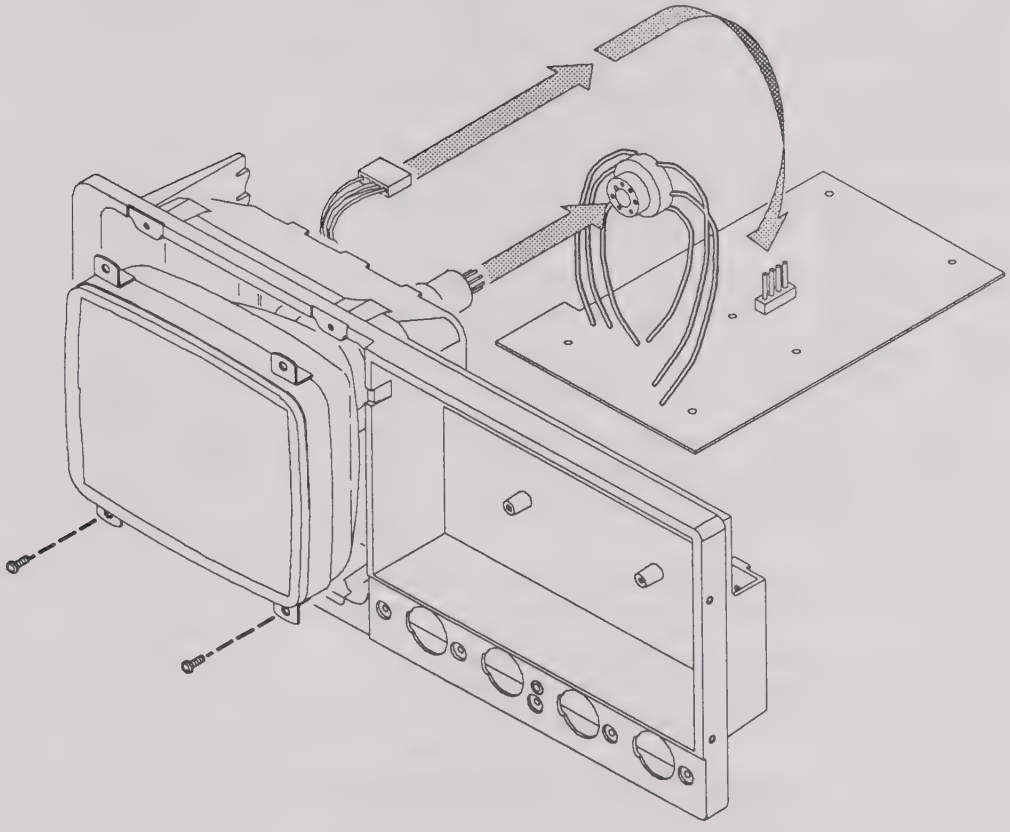


Figure 6-18: Monitor Assembly Removal

5. *Remove the monitor supply board:* Use Figure 6-19 as a guide.

   a. Remove the six screws that mount the high-voltage supply board to the main chassis.

   b. Now, grasp the high-voltage supply board at the points indicated and move the board forward about an inch to clear the retainer built into the left side of the main chassis.

   c. Once the retainer is cleared, work from the front and top to tilt the board so its right edge is up and its left side is down and lift it out of the top of the oscilloscope's main chassis.

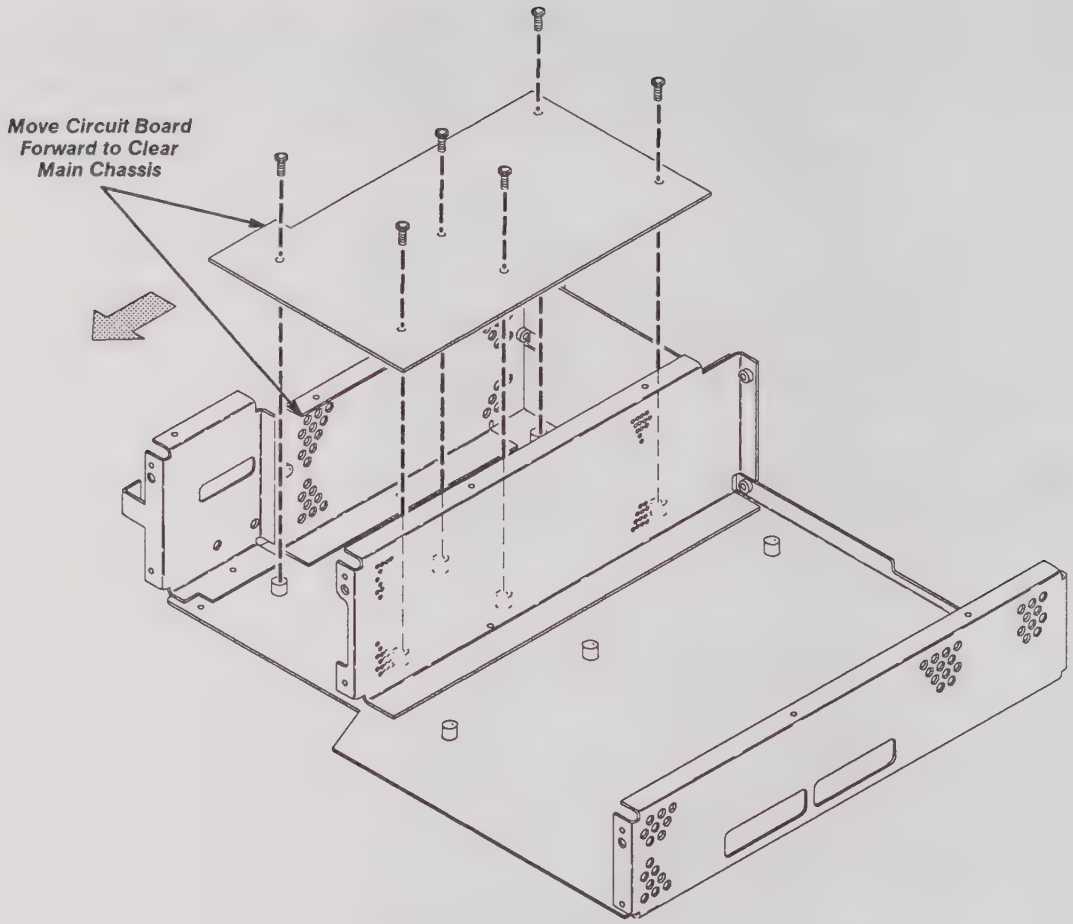


Figure 6-19: ***Monitor Circuit Board Removal***

6. *Reinstallation:*

   a. Perform, in reverse order, substeps 5a–5c, reversing each step to reinstall high-voltage supply board.

   b. Perform, in reverse order, substeps 4a–4e, reversing each step to reinstall the monitor if removed.

   c. See step 3 to reinstall the supply fuse if was removed.

   d. See the following procedures, in order, to complete reassembly of the oscilloscope:

      - *Top Cover and Board Brackets* (top cover only).
      - *A11 Processor/Display Board.*
      - *A14 D1 Bus and Analog-Power and Digital-Power Cables.*
      - *Display-Frame Assembly.*

- *A12 Front Cover, Trim Ring, Menu Buttons, and Attenuator Panel* (page 6-21).
- *Rear Cover and Cabinet* (page 6-19) (completes reassembly)

Front Subpanel

Additional Modules Removed: *display-frame assembly* and *monitor.*

1. *Assemble equipment and locate modules to be removed :*
   a. Have handy a screwdriver with a size T-15 Torx® tip (Items 1 and 2).
   b. Perform the procedure *A20 Display Assembly and Supply Fuse.* Do not remove the high-voltage supply board.
   c. Locate the modules to be removed in the locator diagram *Inner-Chassis Modules*, Figure 6-2, page 6-13.
2. *Orient the oscilloscope:* Set the oscilloscope so its rear is down on the work surface and its bottom is facing you.
3. *Remove the front subpanel:* Remove the six screws securing the front subpanel to the main chassis. (See Figure 6-20 for screw locations.) Lift the front subpanel up away from the main chassis to complete the removal.
4. *Reinstallation:* Perform the following substeps to reinstall the front subpanel and reassemble the remainder of the oscilloscope:
   a. Align the front subpanel to the main chassis, taking care to ensure that the main chassis slips into its alignment slot on the front subpanel (see magnified view, Figure 6-20.) Then reinstall the six screws removed in step 3.
   b. See the procedure *A20 Display Assembly and Supply Fuse* to reinstall the display-frame assembly and monitor.
   c. See the procedures *A12 Front-panel Assembly and A13 Firmware Board , Top Cover and Board Brackets*, *A11 Processor/Display Board*,*A14 D1 Bus and Analog-Power and Digital-Power Cables*,*A12 Front Cover, Trim Ring, Menu Buttons, and Attenuator Panel* (page 6-21), and *Rear Cover and Cabinet* (page 6-19) to instructions for reinstalling those modules.

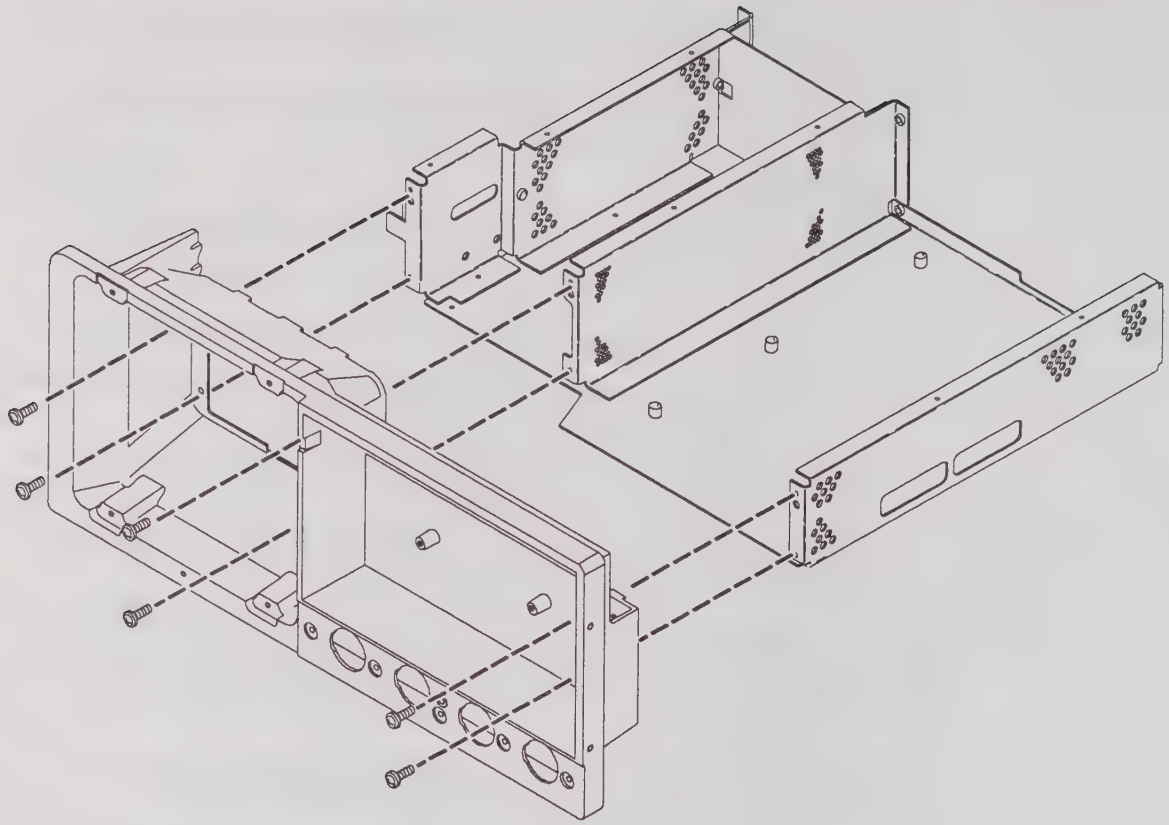


Figure 6-20: ***Front Subpanel Removal***

Main Chassis

Additional Modules Removed: All.

1. *Remove the main chassis:* Since the removal of the main chassis requires the removal of virtually all modules, perform the procedure *Disassembly for Cleaning* that follows. While performing *Disassembly for Cleaning,* you will remove the front-panel assembly. Ignore the instructions to disassemble that assembly.
2. *Reinstallation:* See reinstallation instructions in *Disassembly for Cleaning.*

Disassembly for Cleaning

This procedure is for disassembly of the TDS 520 Digitizing Oscilloscope into its individual modules so they can be cleaned. For the cleaning instructions, see *Inspection and Cleaning*, which begins this section.

1. *Assemble equipment and locate modules to be removed:*
   a. Have handy a screwdriver with a size T-15 Torx® tip (Items 1 and 2), a T-20 Torx® tip (Item 3), a flat-bladed screwdriver (Item 6-11), and a pair of angle-tip tweezers (Item 6-11).
   b. Familiarize yourself with the modules illustrated in Figure 3-1.
2. *Remove external modules:* Do in order the following procedures. They are found under *Procedures for External Modules* which starts on page 6-16.
   a. *Line Fuse and Line Cord*
   b. *Rear Cover and Cabinet*
   c. *A12 Front Cover, Trim Ring, Menu Buttons, and Attenuator Panel*
   d. *Front Subpanel* and *Display-Frame Assembly*.
3. *Remove the outer-chassis modules:* Do in order the following procedures.They are found under *Procedures for Outer-Chassis Modules* which start on page 6-28.
   a. *Fan*
   b. *A14 D1 Bus and Analog-Power and Digital-Power Cables*
   c. *A11 Processor/Display Board*
   d. *Top Cover and Board Brackets*
   e. *A15 Attenuator Assembly*
   f. *A9Acquisition Board*
4. *Remove the inner-chassis modules:* Do in order the following procedures. They are found under *Procedures for Inner-Chassis Modules* which start on page 6-38.
   a. *A16 Power Supply*
   b. *A20 Display Assembly and Supply Fuse*
5. *Disassemble the chassis:* Set the assembly so its bottom is down on the work surface and its front is facing you. Now remove the six screws securing the front subpanel to the main chassis. (See Figure 6-20 for screw location.) Lift the front subpanel up away from the main chassis. Now remove the five screws securing the rear chassis to the main chassis and separate the two chassis. (See Figure 6-16 for screw location.)
6. *Reassembly:* Perform the following substeps:
   a. *Reassemble the chassis:* Align the rear chassis to the main chassis and reinstall the five screws removed in step 5; align the front subpanel to the main chassis and reinstall the six screws removed in step 5.

NOTE

The following substeps refer you to procedures for installing each module removed. When reinstalling the modules, ignore any instructions that require connecting a cable or bus to an module that you have not yet installed. The necessary connections will be made when you install the missing module later.

b. *Reinstall the inner-chassis modules:* Do in the order listed the following procedures. When doing these procedures, do their steps in reverse order. These procedures are found under *Procedures for Inner-Chassis Modules* which start on page 6-38.

- *A20 Display Assembly and Supply Fuse*.
- *A16 Power Supply*

c. *Reinstall the outer-chassis modules:* Do in the order listed the following procedures. When doing these procedures, do their steps in reverse order.These procedures are found under *Procedures for Outer-Chassis Modules* which start on page 6-28.

- *A15 Attenuator Assembly*
- *Top Cover and Board Brackets*
- *A11 Processor/Display Board*
- *A14 D1 Bus and Analog-Power and Digital-Power Cables*
- *Fan*
- *A9Acquisition Board*

d. *Reinstall external modules:* Do in the order listed the following procedures. When doing these procedures, do the steps in reverse order. These procedures are found under *Procedures for External Modules* which starts on page 6-16.

- *Front Subpanel* and *Display-Frame Assembly*.
- *A12 Front Cover, Trim Ring, Menu Buttons, and Attenuator Panel*
- *Rear Cover and Cabinet*
- *Line Fuse and Line Cord*

Troubleshooting

This subsection contains information and procedures designed to help you isolate faulty modules in the oscilloscope. If a module needs to be replaced, follow the *Removal and Installation Procedures* located in this section.

TDS 520 Diagnostics

The oscilloscope has two levels of internal diagnostics that focus on verifying, adjusting, and if need be isolating faulty modules.

Both levels of internal diagnostics report any bad modules and/or interfaces. If they do find a bad module and/or interface, use the troubleshooting procedures in this section to determine which module needs to be replaced.

The two levels of diagnostics are the short confidence set and an extended set that tests the oscilloscope circuitry in-depth and takes more time. At power up, the oscilloscope automatically executes the short set. The extended set is optional and is executed by using the following procedure:

Prerequisites: Power up the oscilloscope and allow a 20 minute warm-up before doing this procedure.

1. *Display the System diagnostics menu:*
   - Press **SHIFT**; then press **UTILITY**.
   - Repeatedly press the main-menu button **System** until **Diag/Err** is highlighted in the pop-up menu.
2. *Run the System Diagnostics:* Press the main-menu button **Execute**; then press the side-menu button **OK Confirm Run Test**.

3. *Wait:* The internal diagnostics do an exhaustive verification of proper oscilloscope function. This verification will take about two minutes. While it progresses, a "clock" icon (shown at left) is displayed on-screen. When finished, the screen will report any bad modules and/or interfaces.

Firmware Updates

The TDS 520 firmware updates are easy to do. Simply install the firmware disks on your PC and follow the instructions in the README file located on the first disk.

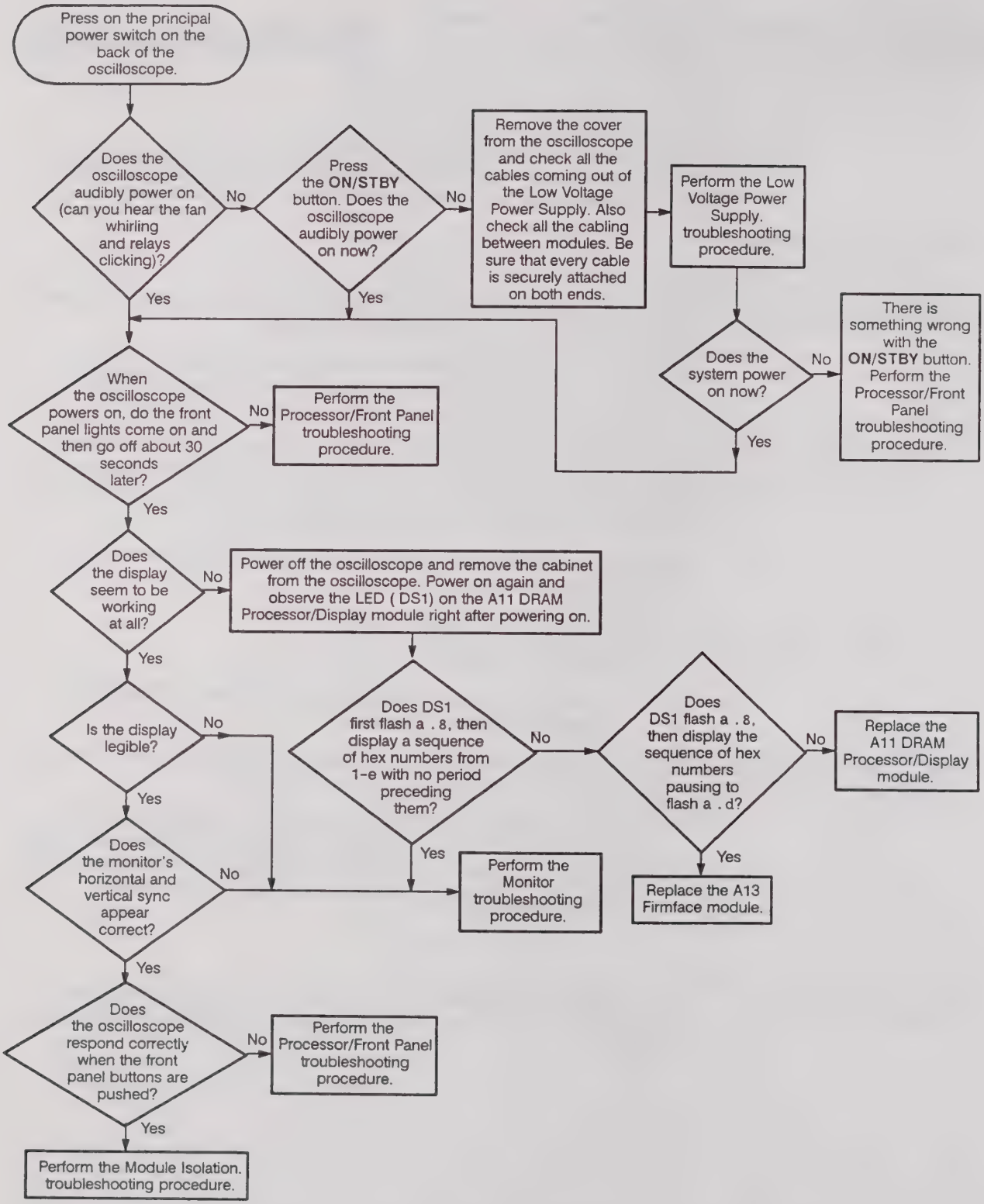

Press on the principal power switch on the back of the oscilloscope.
Does the oscilloscope audibly power on (can you hear the fan whirling and relays clicking)?
No
Yes
Press the ON/STBY button. Does the oscilloscope audibly power on now?
No
Yes
Remove the cover from the oscilloscope and check all the cables coming out of the Low Voltage Power Supply. Also check all the cabling between modules. Be sure that every cable is securely attached on both ends.
Perform the Low Voltage Power Supply. troubleshooting procedure.
Does the system power on now?
No
Yes
There is something wrong with the ON/STBY button. Perform the Processor/Front Panel troubleshooting procedure.
When the oscilloscope powers on, do the front panel lights come on and then go off about 30 seconds later?
No
Perform the Processor/Front Panel troubleshooting procedure.
Yes
Does the display seem to be working at all?
No
Power off the oscilloscope and remove the cabinet from the oscilloscope. Power on again and observe the LED (DS1) on the A11 DRAM Processor/Display module right after powering on.
Yes
Is the display legible?
No
Yes
Does DS1 first flash a . 8, then display a sequence of hex numbers from 1-e with no period preceding them?
No
Yes
Does DS1 flash a . 8, then display the sequence of hex numbers pausing to flash a . d?
No
Yes
Replace the A11 DRAM Processor/Display module.
Replace the A13 Firmface module.
Does the monitor's horizontal and vertical sync appear correct?
No
Yes
Perform the Monitor troubleshooting procedure.
Does the oscilloscope respond correctly when the front panel buttons are pushed?
No
Yes
Perform the Processor/Front Panel troubleshooting procedure.
Perform the Module Isolation. troubleshooting procedure.

Figure 6-21: Primary Failure Troubleshooting Procedure

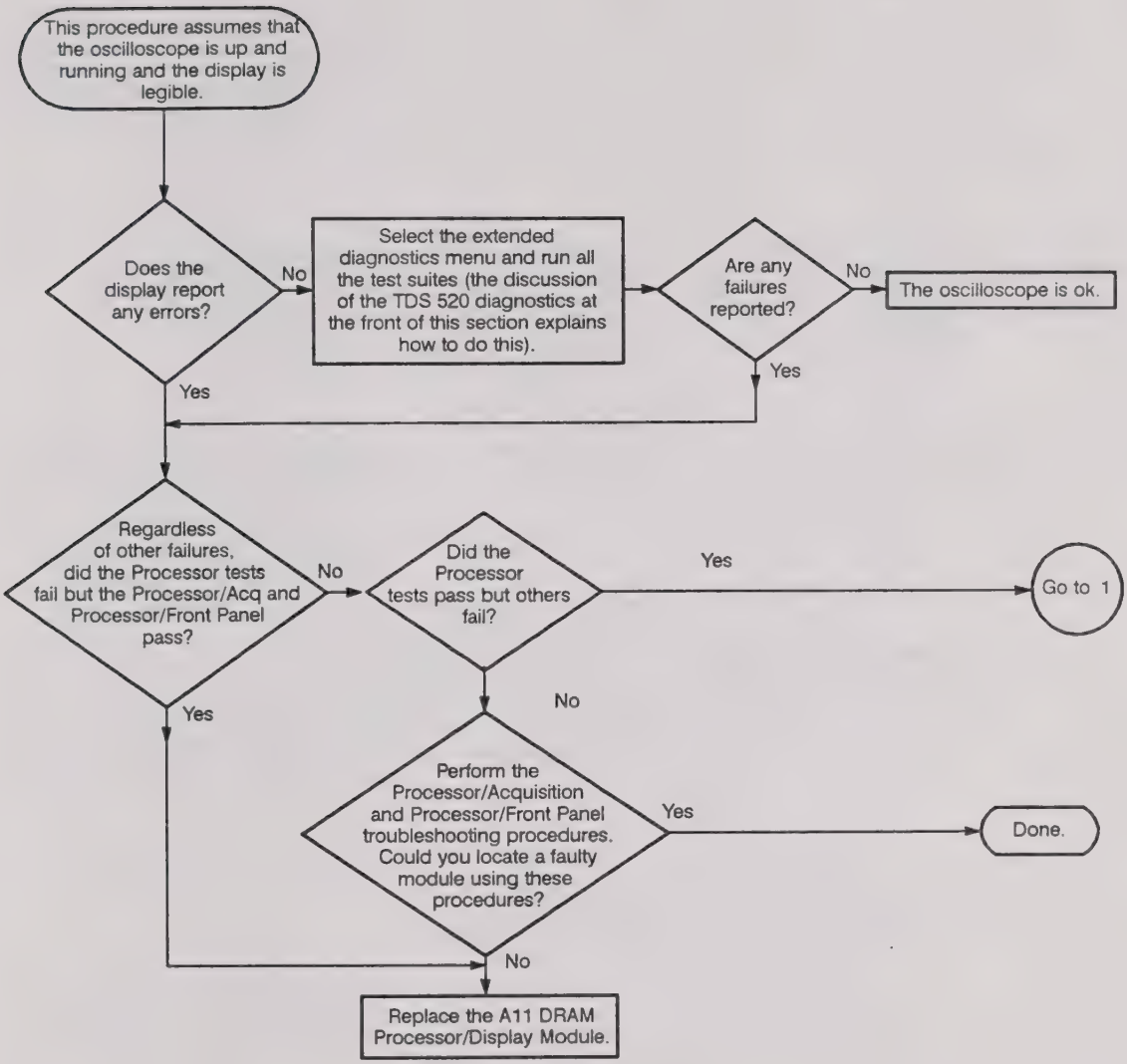
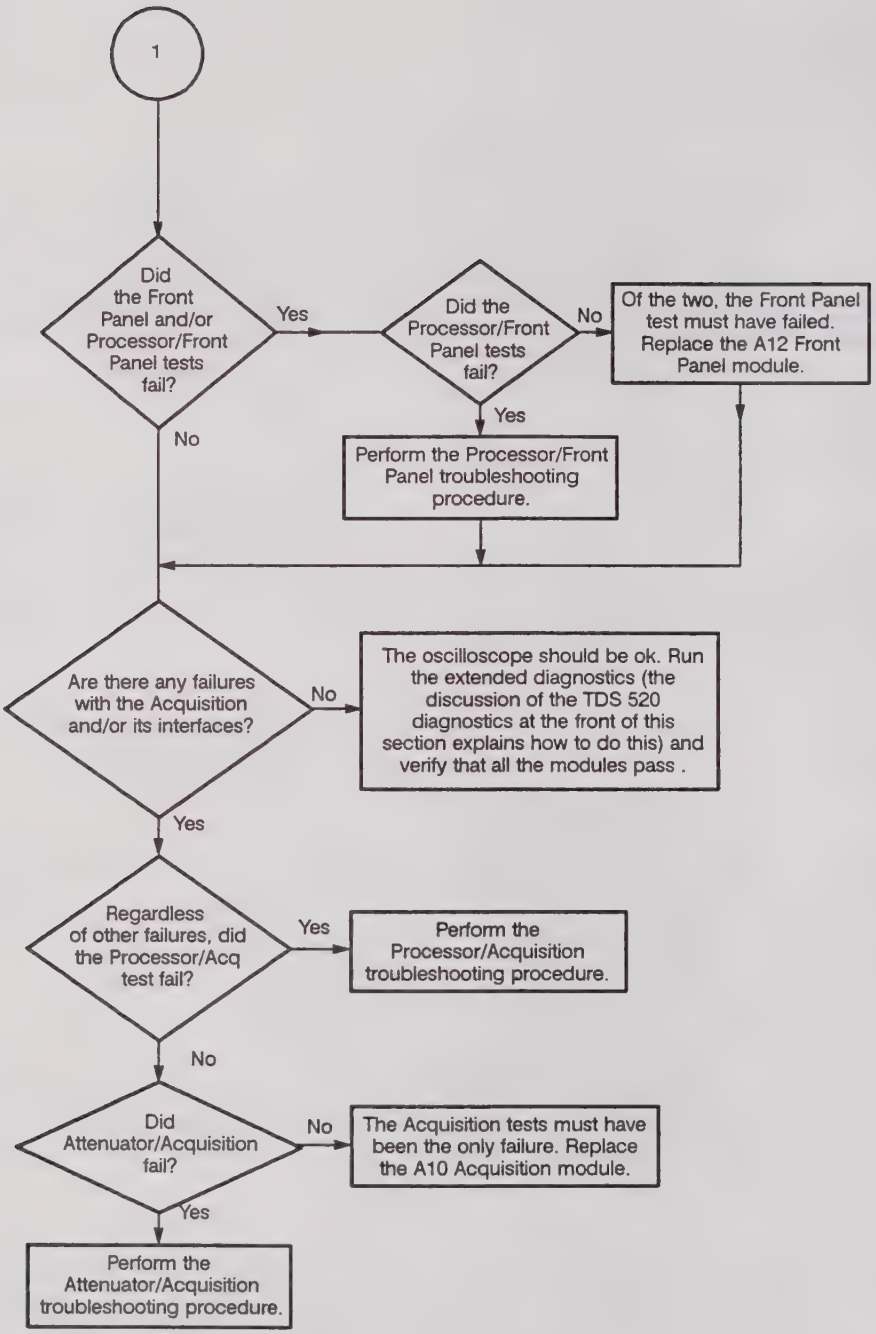

This procedure assumes that the oscilloscope is up and running and the display is legible.
Does the display report any errors?
No
Select the extended diagnostics menu and run all the test suites (the discussion of the TDS 520 diagnostics at the front of this section explains how to do this).
Are any failures reported?
No
The oscilloscope is ok.
Yes
Yes
Regardless of other failures, did the Processor tests fail but the Processor/Acq and Processor/Front Panel pass?
No
Did the Processor tests pass but others fail?
Yes
Go to 1
No
Yes
Perform the Processor/Acquisition and Processor/Front Panel troubleshooting procedures. Could you locate a faulty module using these procedures?
Yes
Done.
No
Replace the A11 DRAM Processor/Display Module.

Figure 6-22: Module Isolation Troubleshooting Procedure


1
Did the Front Panel and/or Processor/Front Panel tests fail?
Yes
Did the Processor/Front Panel tests fail?
No
Of the two, the Front Panel test must have failed. Replace the A12 Front Panel module.
Yes
Perform the Processor/Front Panel troubleshooting procedure.
No
Are there any failures with the Acquisition and/or its interfaces?
No
The oscilloscope should be ok. Run the extended diagnostics (the discussion of the TDS 520 diagnostics at the front of this section explains how to do this) and verify that all the modules pass .
Yes
Regardless of other failures, did the Processor/Acq test fail?
Yes
Perform the Processor/Acquisition troubleshooting procedure.
No
Did Attenuator/Acquisition fail?
No
The Acquisition tests must have been the only failure. Replace the A10 Acquisition module.
Yes
Perform the Attenuator/Acquisition troubleshooting procedure.

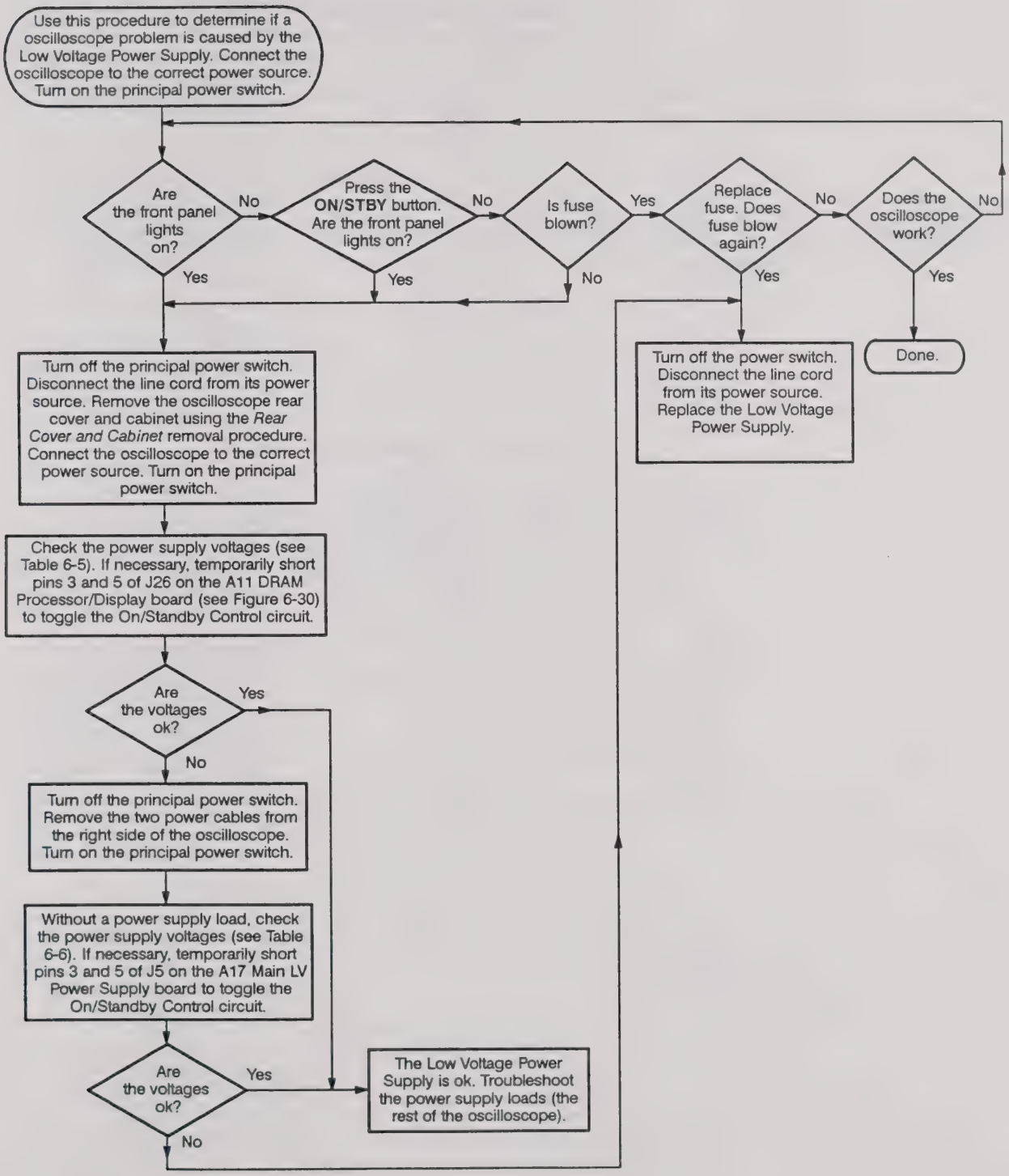

Use this procedure to determine if a oscilloscope problem is caused by the Low Voltage Power Supply. Connect the oscilloscope to the correct power source. Turn on the principal power switch.
Are the front panel lights on?
No
Press the ON/STBY button. Are the front panel lights on?
No
Is fuse blown?
Yes
Replace fuse. Does fuse blow again?
No
Does the oscilloscope work?
No
Yes
Yes
No
Yes
Yes
Turn off the principal power switch. Disconnect the line cord from its power source. Remove the oscilloscope rear cover and cabinet using the Rear Cover and Cabinet removal procedure. Connect the oscilloscope to the correct power source. Turn on the principal power switch.
Turn off the power switch. Disconnect the line cord from its power source. Replace the Low Voltage Power Supply.
Done.
Check the power supply voltages (see Table 6-5). If necessary, temporarily short pins 3 and 5 of J26 on the A11 DRAM Processor/Display board (see Figure 6-30) to toggle the On/Standby Control circuit.
Are the voltages ok?
Yes
No
Turn off the principal power switch. Remove the two power cables from the right side of the oscilloscope. Turn on the principal power switch.
Without a power supply load, check the power supply voltages (see Table 6-6). If necessary, temporarily short pins 3 and 5 of J5 on the A17 Main LV Power Supply board to toggle the On/Standby Control circuit.
Are the voltages ok?
Yes
No
The Low Voltage Power Supply is ok. Troubleshoot the power supply loads (the rest of the oscilloscope).

Figure 6-23: Low Voltage Power Supply Module Isolation

Table 6-5: Normal Supply Voltages
(measured at the power supply connector)

Supply	Lower Limit	Upper Limit
+5.1 VA	+5.0 V	+5.2 V
+5.1 VB	+5.0 V	+5.2 V
+25 V	+23.5 V	+27.5 V
+5 V	+4.9 V	+5.1 V
-5.1 V	-4.9 V	-5.2 V
+15 V	+14.7 V	+15.3 V
-15 V	-14.7 V	-15.3 V

Table 6-6: No-Load Supply Voltages

Supply	Lower Limit	Upper Limit
+5.1 VA	+4.95 V	+5.25 V
+5.1 VB	+4.95 V	+5.25 V
+25 V	+23.5 V	+27.5 V
+5 V	+0.59 V	+0.81 V
-5.1 V	-0.39 V	-0.61 V
+15 V	+1.05 V	+1.75 V
-15 V	-1.05 V	-1.75 V

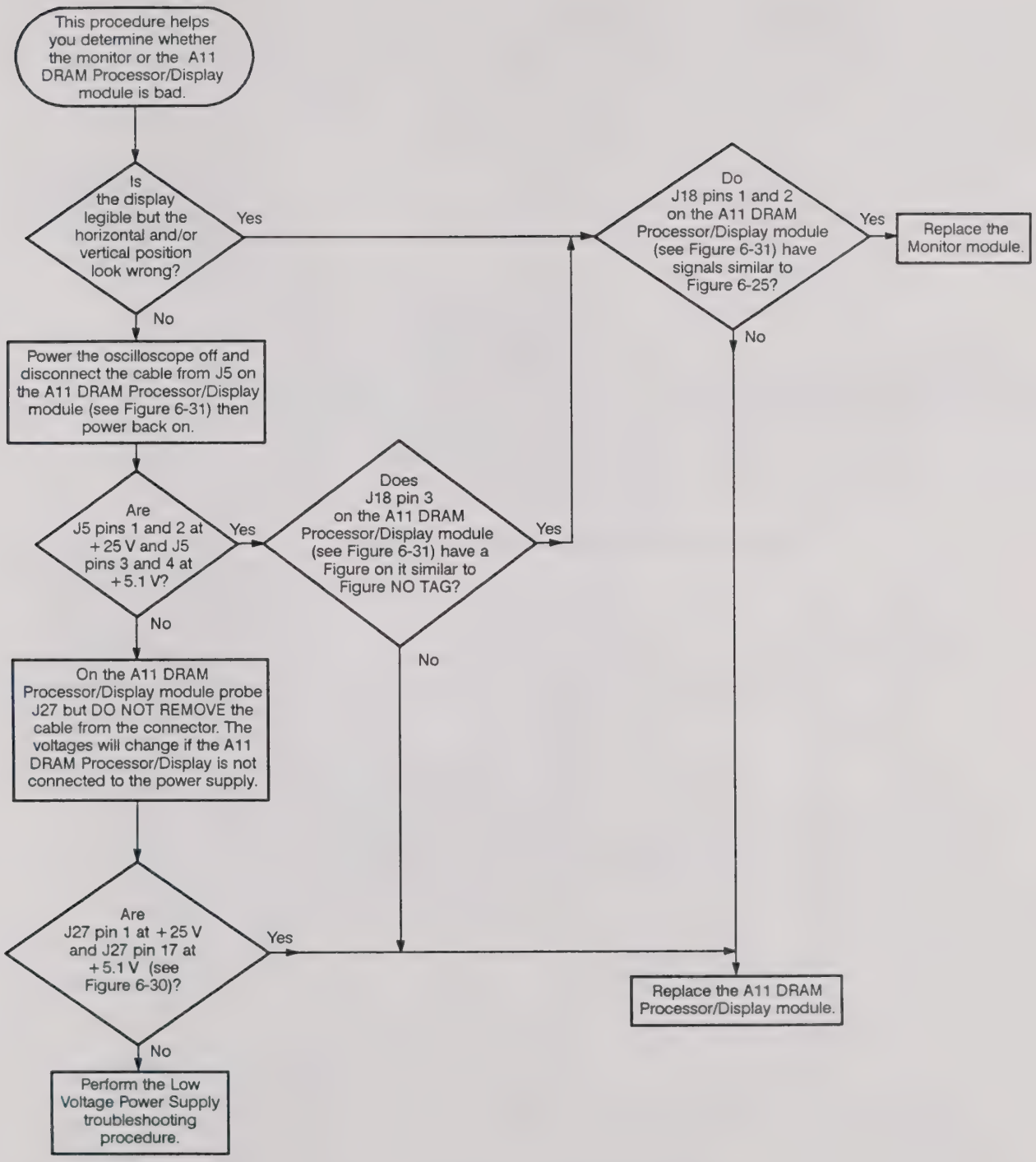

This procedure helps you determine whether the monitor or the A11 DRAM Processor/Display module is bad.
Is the display legible but the horizontal and/or vertical position look wrong?
Yes
No
Do J18 pins 1 and 2 on the A11 DRAM Processor/Display module (see Figure 6-31) have signals similar to Figure 6-25?
Yes
Replace the Monitor module.
No
Power the oscilloscope off and disconnect the cable from J5 on the A11 DRAM Processor/Display module (see Figure 6-31) then power back on.
Are J5 pins 1 and 2 at +25 V and J5 pins 3 and 4 at +5.1 V?
Yes
Does J18 pin 3 on the A11 DRAM Processor/Display module (see Figure 6-31) have a Figure on it similar to Figure NO TAG?
Yes
No
No
On the A11 DRAM Processor/Display module probe J27 but DO NOT REMOVE the cable from the connector. The voltages will change if the A11 DRAM Processor/Display is not connected to the power supply.
Are J27 pin 1 at +25 V and J27 pin 17 at +5.1 V (see Figure 6-30)?
Yes
Replace the A11 DRAM Processor/Display module.
No
Perform the Low Voltage Power Supply troubleshooting procedure.

Figure 6-24: Monitor Troubleshooting Procedure

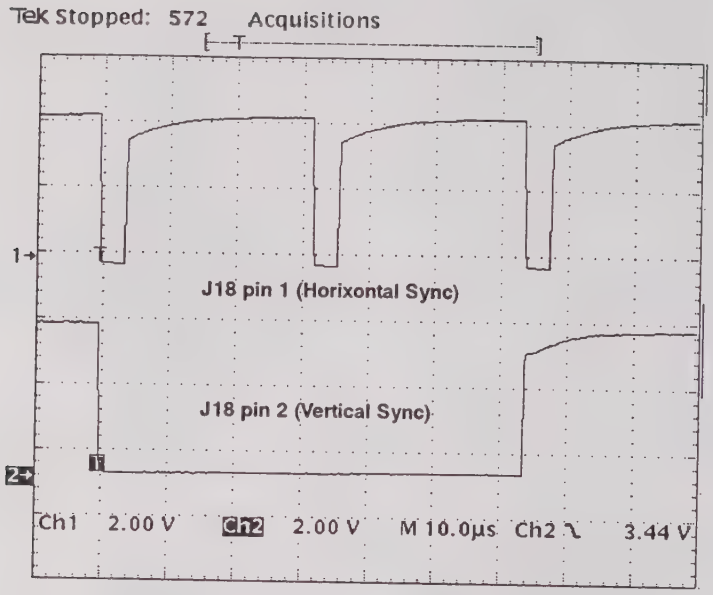


Figure 6-25: Horizontal and Vertical Sync Signals

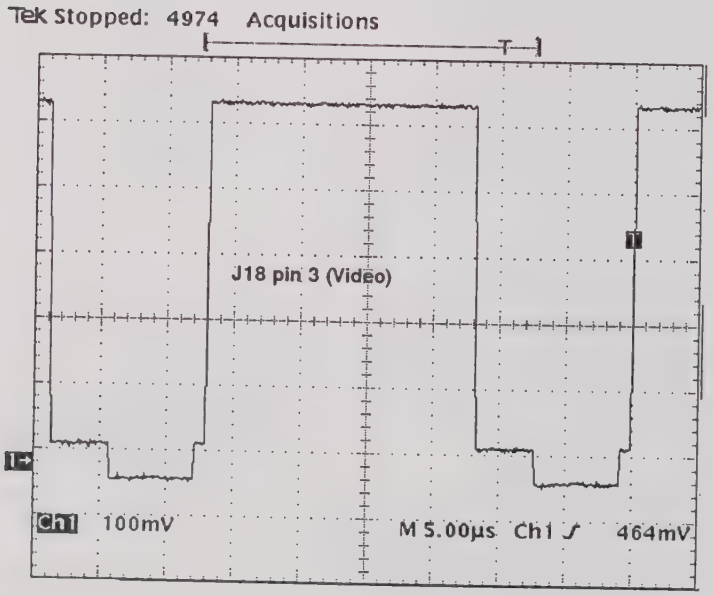


Figure 6-26: Video Out Signal

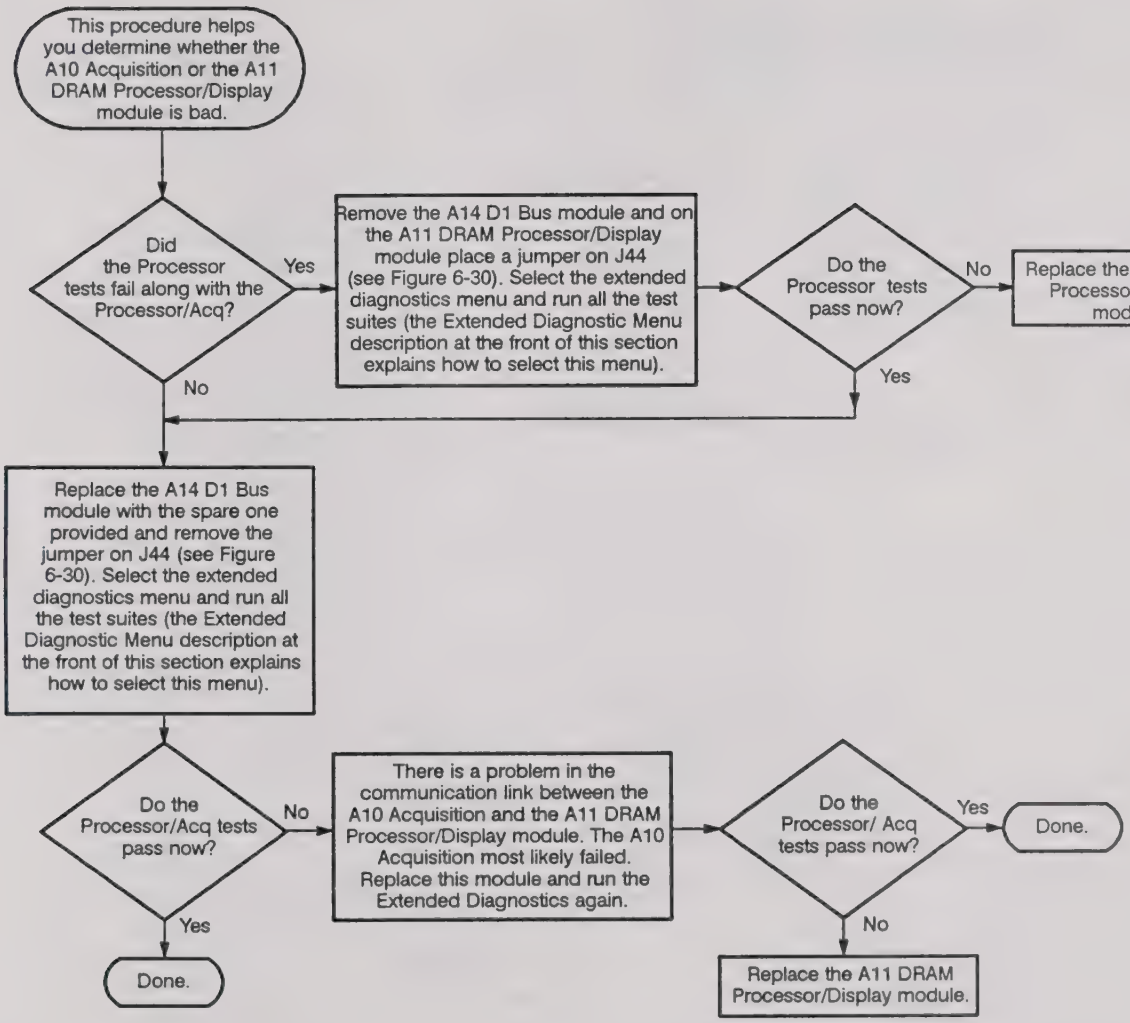

This procedure helps you determine whether the A10 Acquisition or the A11 DRAM Processor/Display module is bad.
Did the Processor tests fail along with the Processor/Acq?
Yes
No
Remove the A14 D1 Bus module and on the A11 DRAM Processor/Display module place a jumper on J44 (see Figure 6-30). Select the extended diagnostics menu and run all the test suites (the Extended Diagnostic Menu description at the front of this section explains how to select this menu).
Do the Processor tests pass now?
No
Yes
Replace the A11 DRAM Processor/Display module.
Replace the A14 D1 Bus module with the spare one provided and remove the jumper on J44 (see Figure 6-30). Select the extended diagnostics menu and run all the test suites (the Extended Diagnostic Menu description at the front of this section explains how to select this menu).
Do the Processor/Acq tests pass now?
No
Yes
Done.
There is a problem in the communication link between the A10 Acquisition and the A11 DRAM Processor/Display module. The A10 Acquisition most likely failed. Replace this module and run the Extended Diagnostics again.
Do the Processor/ Acq tests pass now?
Yes
Done.
No
Replace the A11 DRAM Processor/Display module.

Figure 6-27: Processor/Acquisition Troubleshooting Procedure

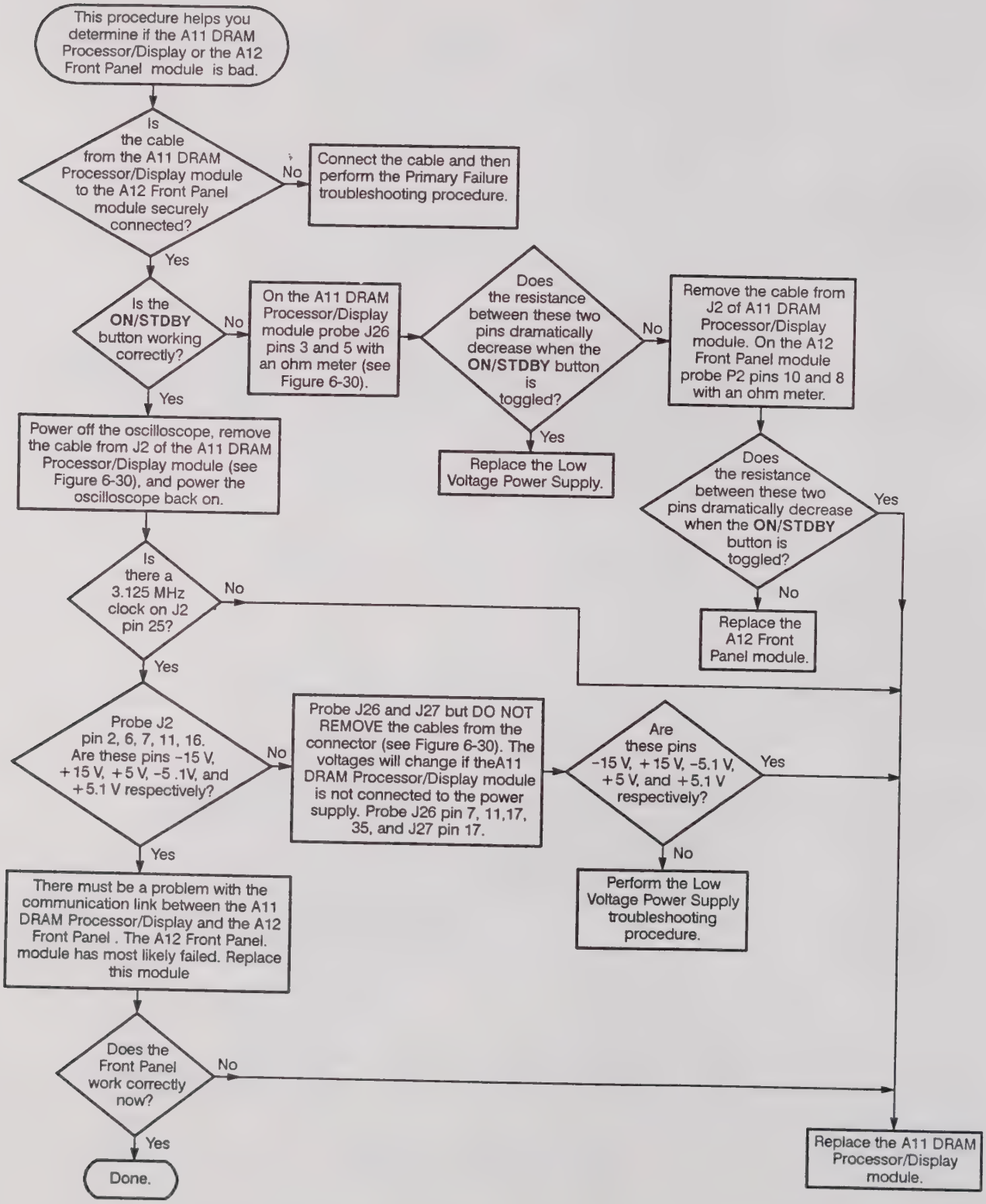

This procedure helps you determine if the A11 DRAM Processor/Display or the A12 Front Panel module is bad.
Is the cable from the A11 DRAM Processor/Display module to the A12 Front Panel module securely connected?
No
Connect the cable and then perform the Primary Failure troubleshooting procedure.
Yes
Is the ON/STDBY button working correctly?
No
On the A11 DRAM Processor/Display module probe J26 pins 3 and 5 with an ohm meter (see Figure 6-30).
Does the resistance between these two pins dramatically decrease when the ON/STDBY button is toggled?
No
Remove the cable from J2 of A11 DRAM Processor/Display module. On the A12 Front Panel module probe P2 pins 10 and 8 with an ohm meter.
Yes
Replace the Low Voltage Power Supply.
Does the resistance between these two pins dramatically decrease when the ON/STDBY button is toggled?
Yes
No
Replace the A12 Front Panel module.
Yes
Power off the oscilloscope, remove the cable from J2 of the A11 DRAM Processor/Display module (see Figure 6-30), and power the oscilloscope back on.
Is there a 3.125 MHz clock on J2 pin 25?
No
Yes
Probe J2 pin 2, 6, 7, 11, 16. Are these pins −15 V, +15 V, +5 V, −5 .1V, and +5.1 V respectively?
No
Probe J26 and J27 but DO NOT REMOVE the cables from the connector (see Figure 6-30). The voltages will change if theA11 DRAM Processor/Display module is not connected to the power supply. Probe J26 pin 7, 11,17, 35, and J27 pin 17.
Are these pins −15 V, +15 V, −5.1 V, +5 V, and +5.1 V respectively?
Yes
No
Perform the Low Voltage Power Supply troubleshooting procedure.
Yes
There must be a problem with the communication link between the A11 DRAM Processor/Display and the A12 Front Panel . The A12 Front Panel. module has most likely failed. Replace this module
Does the Front Panel work correctly now?
No
Yes
Done.
Replace the A11 DRAM Processor/Display module.

Figure 6-28: Processor/Front Panel Troubleshooting Procedure

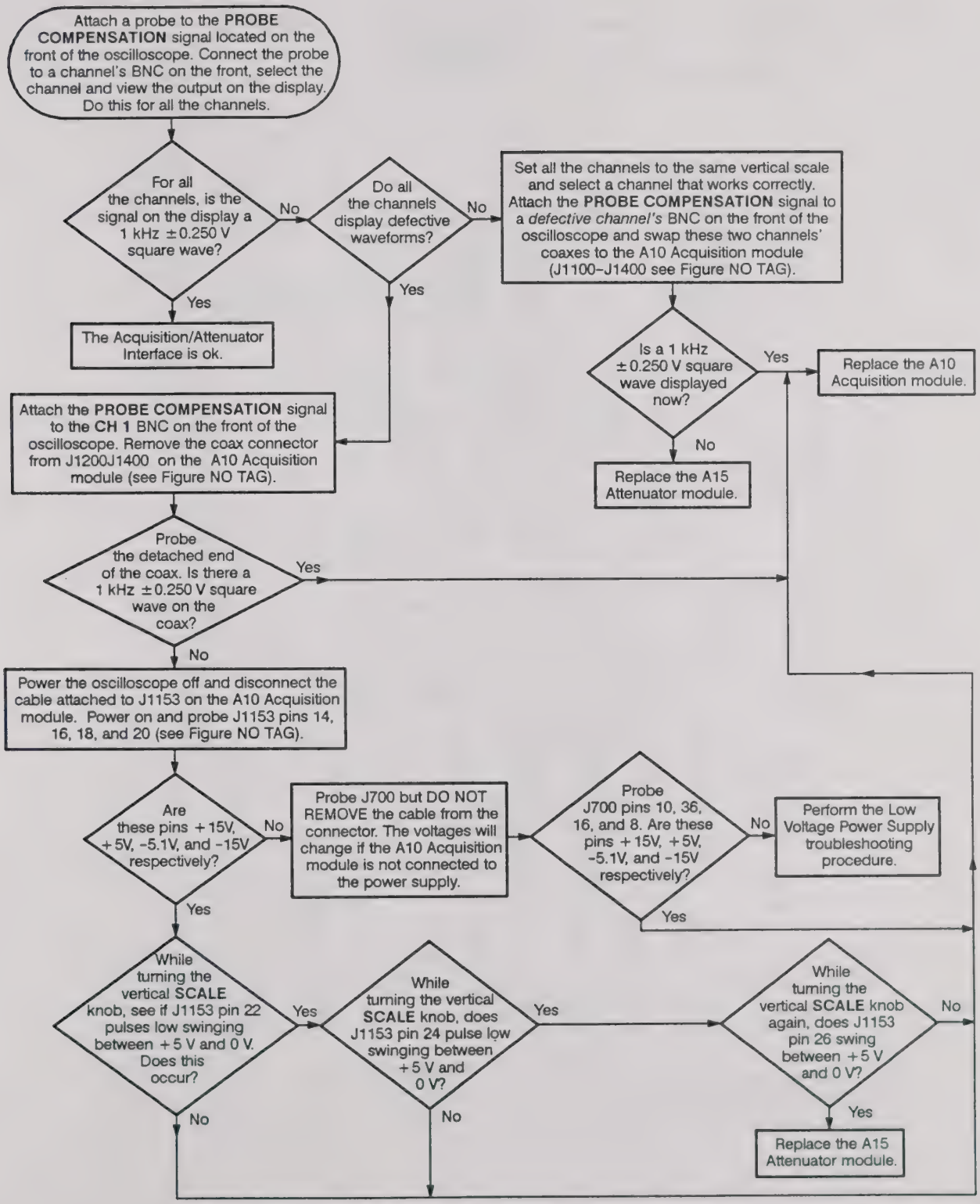

Attach a probe to the PROBE COMPENSATION signal located on the front of the oscilloscope. Connect the probe to a channel's BNC on the front, select the channel and view the output on the display. Do this for all the channels.
For all the channels, is the signal on the display a 1 kHz ±0.250 V square wave?
No
Yes
The Acquisition/Attenuator Interface is ok.
Do all the channels display defective waveforms?
No
Yes
Set all the channels to the same vertical scale and select a channel that works correctly. Attach the PROBE COMPENSATION signal to a defective channel's BNC on the front of the oscilloscope and swap these two channels' coaxes to the A10 Acquisition module (J1100–J1400 see Figure NO TAG).
Is a 1 kHz ±0.250 V square wave displayed now?
Yes
Replace the A10 Acquisition module.
No
Replace the A15 Attenuator module.
Attach the PROBE COMPENSATION signal to the CH 1 BNC on the front of the oscilloscope. Remove the coax connector from J1200J1400 on the A10 Acquisition module (see Figure NO TAG).
Probe the detached end of the coax. Is there a 1 kHz ±0.250 V square wave on the coax?
Yes
No
Power the oscilloscope off and disconnect the cable attached to J1153 on the A10 Acquisition module. Power on and probe J1153 pins 14, 16, 18, and 20 (see Figure NO TAG).
Are these pins +15V, +5V, -5.1V, and -15V respectively?
No
Yes
Probe J700 but DO NOT REMOVE the cable from the connector. The voltages will change if the A10 Acquisition module is not connected to the power supply.
Probe J700 pins 10, 36, 16, and 8. Are these pins +15V, +5V, -5.1V, and -15V respectively?
No
Yes
Perform the Low Voltage Power Supply troubleshooting procedure.
While turning the vertical SCALE knob, see if J1153 pin 22 pulses low swinging between +5 V and 0 V. Does this occur?
Yes
No
While turning the vertical SCALE knob, does J1153 pin 24 pulse low swinging between +5 V and 0 V?
Yes
No
While turning the vertical SCALE knob again, does J1153 pin 26 swing between +5 V and 0 V?
No
Yes
Replace the A15 Attenuator module.

Figure 6-29: Attenuator/AcquisitionTroubleshooting Procedure

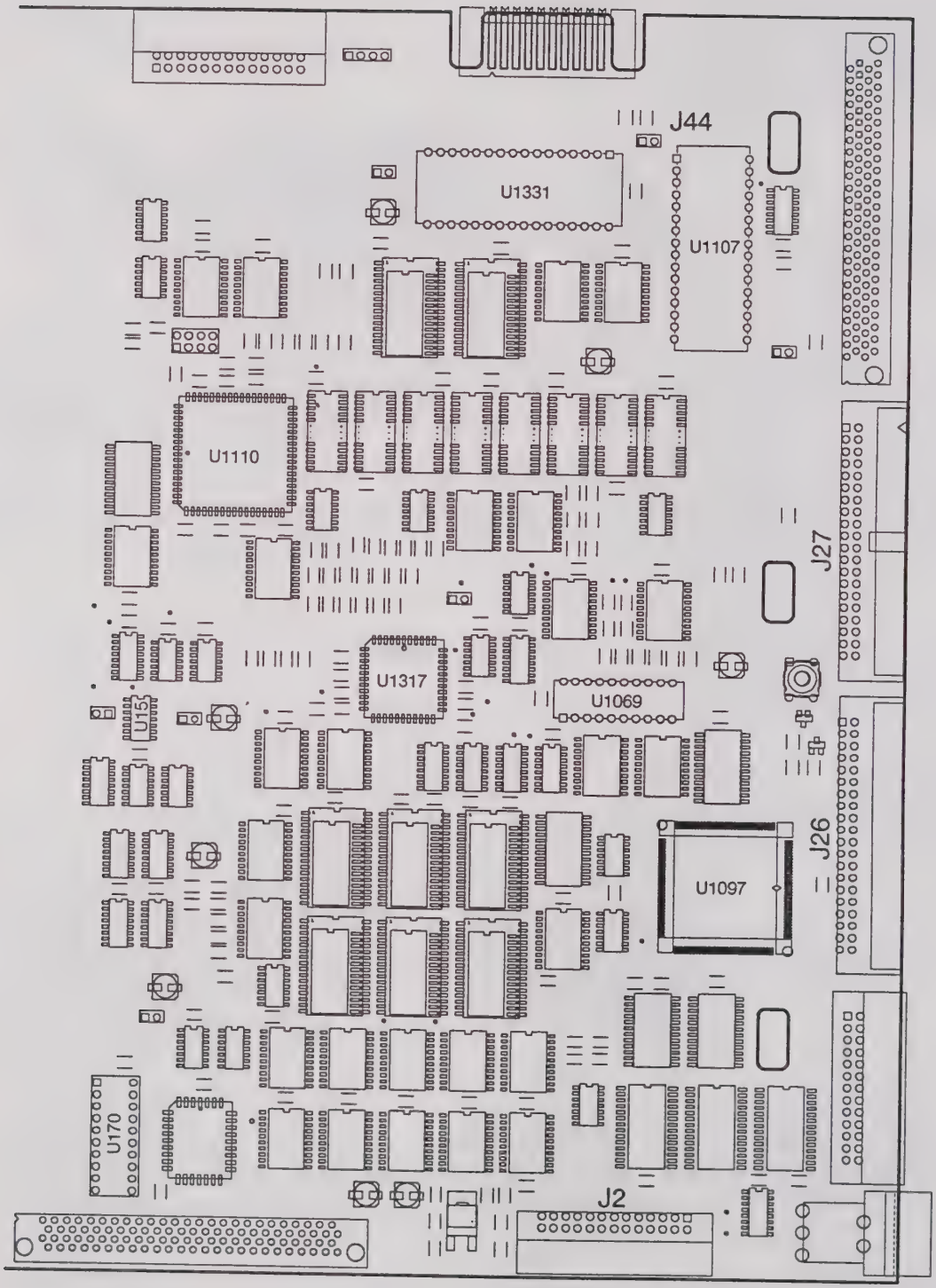


Figure 6-30: A11 DRAM Processor/Display Module (View of right side)

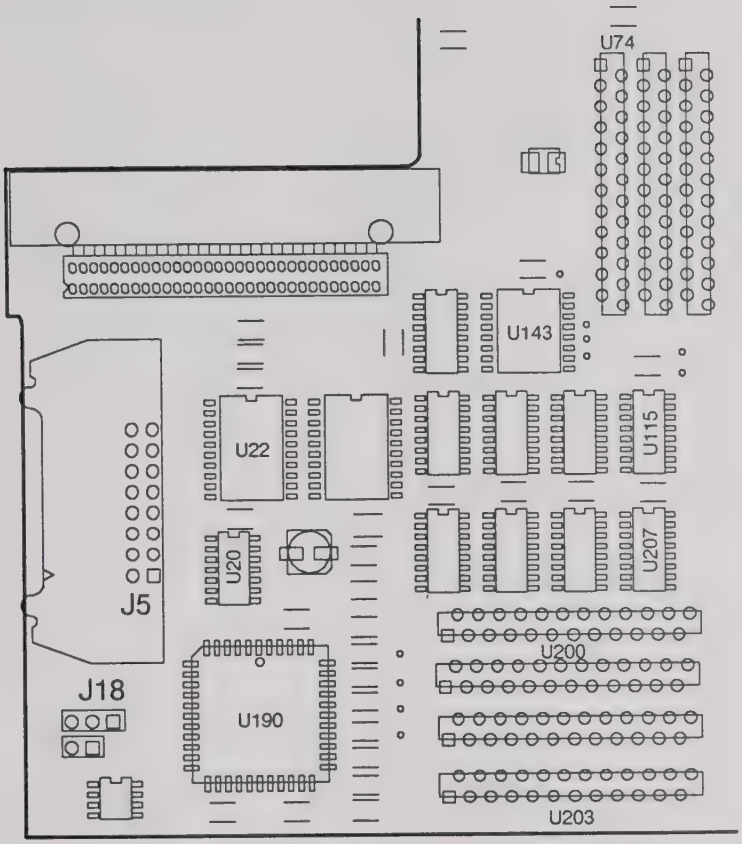


Figure 6-31: A11 DRAM Processor/Display Module (View of lower left corner)

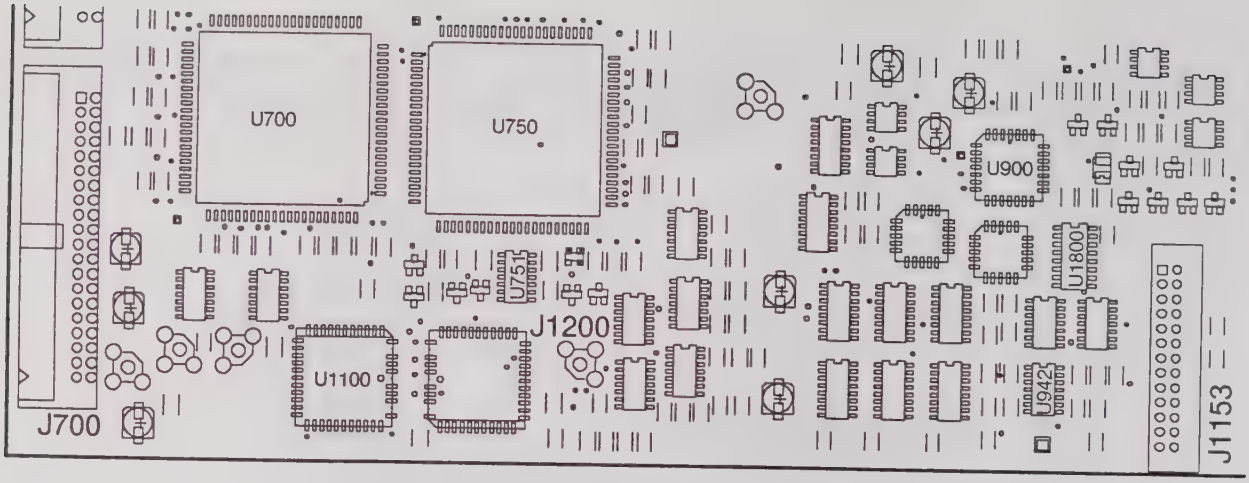


Figure 6-32: A10 Acquisition Module (View of lower left corner)

Options and Accessories

This section describes the various options as well as the standard and optional accessories that are available for the TDS 520 Digitizing Oscilloscope.

Options

Options include:

Options A1–A5: International Power Cords

Besides the standard North American, 110 V, 60 Hz power cord, Tektronix ships any of five alternate power cord configurations with the oscilloscope when ordered by the customer.

Table 7-1: International Power Cords

Option	Power Cord
A1	Universal European – 220 V, 50 Hz
A2	UK – 240 V, 50 Hz
A3	Australian – 240 V, 50 Hz
A4	North American – 240 V, 60 Hz
A5	Switzerland – 220 V, 50 Hz

Option 1M: 50,000 Sample Record Length

This option provides a maximum record length of 50,000 samples per acquisition (50,000/channel).

Option 1R: Rackmounted TDS 520 Digitizing Oscilloscope

Tektronix ships the digitizing oscilloscope, when ordered with Option 1R, configured for installation in a 19 inch wide instrument rack. Customers with instruments not configured for rackmounting can order a rackmount kit (016-1136-00 for field conversions).

Instructions for rackmounting the digitizing oscilloscope are shipped with the rackmount kit or the option 1R.

Rackmounted instruments include holes in their front panels for mounting connectors. You can route signals found at rear-panel connectors to front-panel connectors you install in use these holes. You must provide the cables and connectors to implement such through-panel access. However, you can order them separately as catalog items from Tektronix, Inc.

Option 22: Additional Probes

With this option, Tektronix ships two additional probes identical to the two standard-accessory P6139 probes normally shipped with the instrument. This provides one probe for each front-panel input.

Option 1P: HC100 4 Pen Plotter

With this option, Tektronix ships a four-color plotter designed to make waveform plots directly from the digitizing oscilloscope without requiring an external controller. It handles A4 and US letter size media.

Option 9C: Certificate of Calibration and Test Data Report

Tektronix ships a Certificate of Calibration which states this instrument meets or exceeds all warranted specifications and has been calibrated using standards and instruments whose accuracies are traceable to the National Institute of Standards and Technology, an accepted value of a natural physical constant or a ratio calibration technique. The calibration is in compliance with US MIL-STD 45662A. This option also includes a test data report for the instrument.

Standard Accessories

The following standard accessories are included with the digitizing oscilloscope:

Table 7-2: Standard Accessories

Accessory	Part Number
Tutorial/User Manual	070-8317-00
Programmer Manual	070-8318-00
Quick Reference	070-8316-00
Front Cover	200-3696-00
U.S. Power Cord	161-0230-01
TDS 520 Service Manual (Requires mail in of customer request card included with the instrument)	070-8312-00
TDS 540 Service Manual (Requires mail in of customer request card included with the instrument)	070-8314-00
Probes (qty. two) P6139 10X Passive	P6139 (single unit)

Probe Accessories

These are accessories to the standard probe listed previously (P6139). Except for the probe-tip-to-circuit board adapter, they can also be ordered separately.

Table 7-3: Probe Accessories

Accessory	Part Number
Retractable Hook Tip	013-0107-06
Body shell, tip cover	204-1049-00
Probe-Tip-to-Circuit Board Adapter (qty. two standard, optionally available in package of 25 as 131-5031-00)	No customer orderable part number for double unit
6 Inch Slip-On Ground Lead	196-3113-02
Low Inductance Ground Lead	195-4240-00
Marker Rings Set. Qty. eighteen rings which includes two each of nine colors.	016-0633-00
Ground collar	343-1003-01
6 Inch Alligator Clip Ground Lead	196-3305-00
Screwdriver: adjustment tool, metal tip	003-1433-00
SMT KlipChip™	206-0364-00
Accessory pouch	016-0708-00

Optional Accessories

You can also order the following optional accessories:

Table 7-4: Optional Accessories

Accessory	Part Number
Plotter (GPIB and Centronics Standard)	HC100
Oscilloscope Cart	K218
Rack Mount Kit (for field conversion)	016-1136-00
Oscilloscope Camera	C9
Oscilloscope Camera Adapter	016-1145-00
Soft-Sided Carrying Case	016-0909-01
Transit Case	016-1135-00
GPIB Cable (1 meter)	012-0991-01
GPIB Cable (2 meter)	012-0991-00

Accessory Probes

The following optional accessory probes are recommended for use with your digitizing oscilloscope:

- P6101A 1X, 15 MHz, Passive probe.
- P6156 10X, 3.5 GHz, Passive, low capacitance, (low impedance Zo) probe. Option 25 provides 100X.
- P6009 Passive, high voltage probe, 100X, 1500 VDC + Peak AC
- P6015 Passive extra high voltage probe, 1000X, 20 kVDC + Peak AC (40 kV peak for less than 100 ms)
- P6205 750 MHz probe bandwidth. Active (FET) voltage probe.
- P6204 Active, high speed digital voltage probe. FET. DC to 1 GHz. DC offset. 50 Ω input. Use with 1103 Tekprobe Power Supply for offset control.
- P6046 Active, differential probe, 1X/10X, DC to 100 MHz, 50 Ω input.
- A6501 Buffer Amplifier (active fixtured), 1 GHz, 1 MΩ, 10X.
- P6501 Option 02: Microprobe with TekProbe power cable (active fixtured), 750 MHz, 1 MΩ, 10X.
- AM 503S — DC/AC Current probe system, AC/DC. Uses A6302 Current Probe.
- AM 503S Option 03: DC/AC Current probe system, AC/DC. Uses A6303 Current Probe.
- P6021 AC Current probe. 120 Hz to 60 MHz.
- P6022 AC Current probe. 935 kHz to 120 MHz.
- CT-1 Current probe — designed for permanent or semi-permanent in-circuit installation. 25 kHz to 1 GHz, 50 Ω input.
- CT-2 Current probe — designed for permanent or semi-permanent in-circuit installation. 1.2 kHz to 200 MHz, 50 Ω input.
- CT-4 Current Transformer — for use with the AM 503S (A6302) and P6021. Peak pulse 1 kA. 0.5 Hz to 20 MHz with AM 503S (A6302).
- P6701A Opto-Electronic Converter, 500 to 950 nm, DC to 850 MHz 1 V/mW.
- P6703A Opto-Electronic Converter, 1100 to 1700 nm, DC to 1 GHz 1 V/mW.
- P6711 Opto-Electronic Converter, 500 to 950 nm, DC to 250 MHz 5 V/mW.
- P6712 Opto-Electronic Converter, 1100 to 1700 nm, DC to 300 MHz. 5 V/mW.
- TVC 501 Time-to-voltage converter. Time delay, pulse width and period measurements.

Probe Accessories

The following optional accessories are recommended for use with the standard probe listed under *Standard Accessories.*

Table 7-5: Probe Accessories

Accessory	Part Number
Connector, BNC: BNC to Probe Tip Adapter	013-0226-00
Connector, BNC: 50 Ω, BNC to Probe Tip Adapter	013-0227-00
Connector, Probe: Package of 100, compact	131-4244-00
Connector, Probe: Package of 25, compact	131-5031-00
Screwdriver Adjustment Tool, Package of five	003-1433-01
Compact-to-Miniature Probe Tip Adapter	013-0202-02
Probe Tip Holder: (holds three tips)	352-0670-00
3 Inch Slip-On Ground Lead	196-3113-03
Probe Holder: Black ABS	352-0351-00
IC Protector Tip, Package of 10	015-0201-07
IC Protector Tip, Package of 100	015-0201-08
Marker Ring Set: Two each of nine colors	016-0633-00
SMT KlipChip™: 20 Adapters	SMG50
Low-Inductance Spring-Tips: Two each of five different springs and insulator	016-1077-00
Probe Tip-to-Chassis Adapter	131-4210-00

NOTE

The next four items below can only be used with the Compact-to-Miniature Probe Tip Adapter.

Dual-Lead Adapter	015-0325-00
BNC-to-Probe Tip Adapter	013-0084-01
G.R.-to-Probe Tip Adapter, 50 Ω	017-0088-00
Bayonet Ground Assembly	013-0085-00

Accessory Software

The following optional accessories are Tektronix software products recommended for use with your digitizing oscilloscope:

Table 7-6: Accessory Software

Software	Part Number
EZ-Test Program Generator	S45F030
Wavewriter: AWG and waveform creation	S3FT400
TekTMS: Test management system	S3FT001
LabWindows	S3FG910

Warranty

The standard warranty is three years. It covers all labor and parts, including CRT, and excludes probes.

Replaceable Electrical Parts List

The modules that make up this instrument are often a combination of mechanical and electrical subparts. Therefore, all replaceable modules are listed in Section 10, *Replaceable Parts List.* Refer to that section for part numbers when using this manual.

Replace this page with the tab divider of the same name.

Diagrams

This contains the block diagram and the interconnection diagram for this oscilloscope.

Symbols

Graphic symbols and class designation letters are based on ANSI Standard Y32.2-1975. Abbreviations are based on ANSI Y1.1-1972.

Logic symbology is based on ANSI/IEEE Std 91-1984 in terms of positive logic. Logic symbols depict the logic function performed and can differ from the manufacturer's data.

The tilde (~) preceding a signal name indicates that the signal performs its intended function when in the low state.

Other standards used in the preparation of diagrams by Tektronix. Inc are:

- Tektronix Standard 062-2476 Symbols and Practices for Schematic Drafting
- ANSI Y14.159-1971 Interconnection Diagrams
- ANSI Y32.16-1975 Reference Designations for Electronic Equipment
- MIL-HDBK-63038-1A Military Standard Technical Manual Writing Handbook

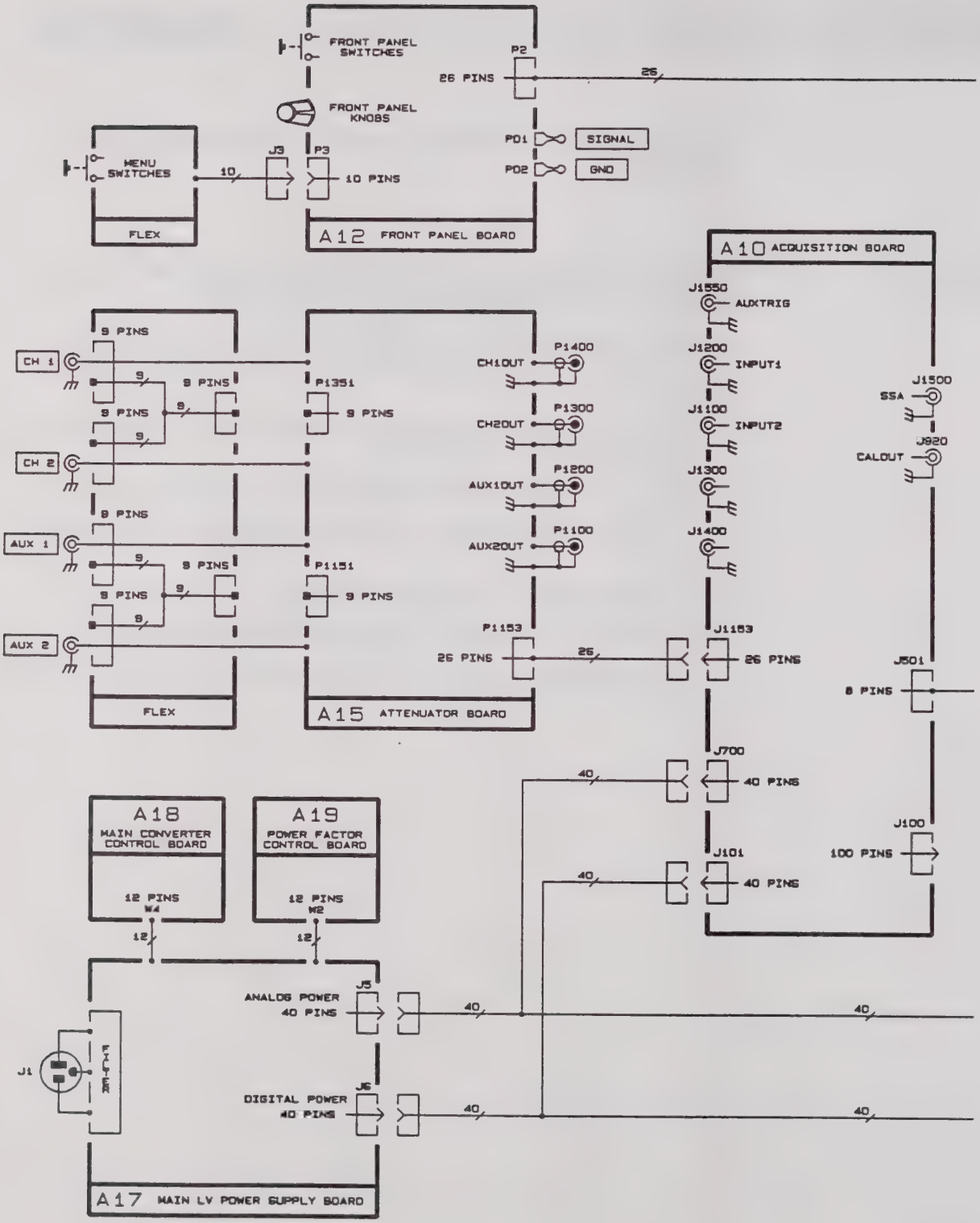


Figure 9-1: TDS 520 Interconnections ◇0

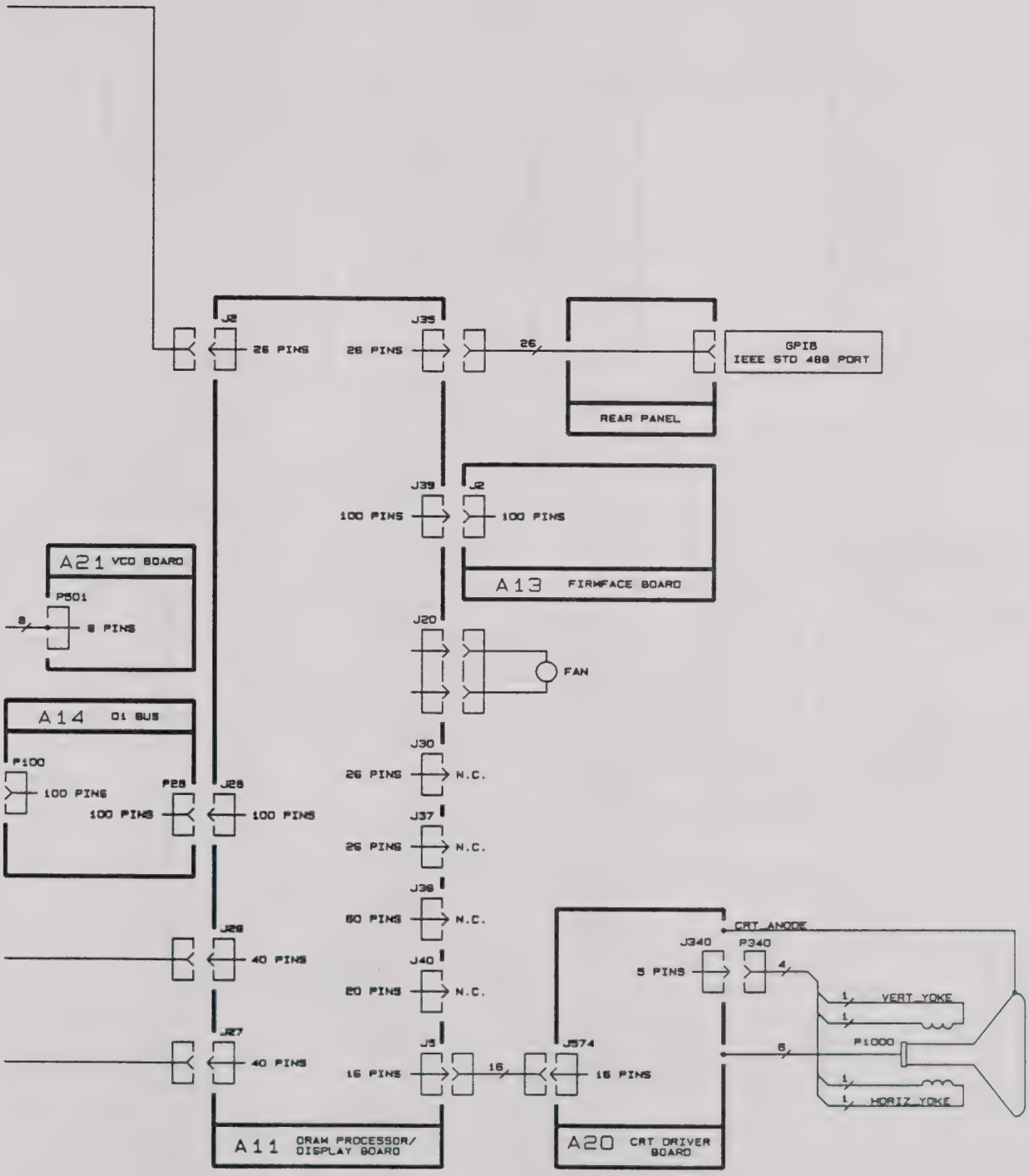


Figure 9-1: TDS 520 Interconnections ◇0◇ (Cont.)

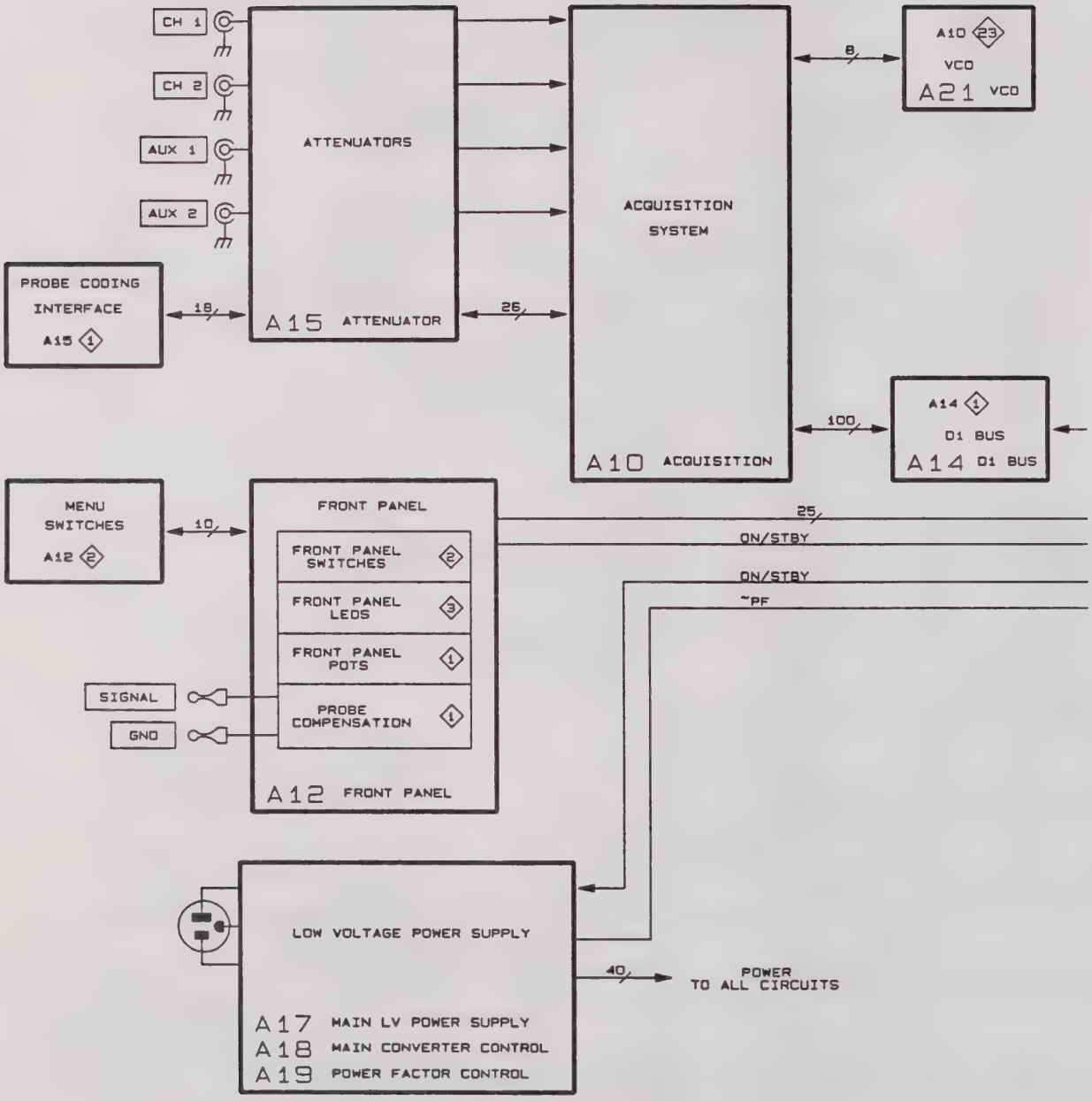


Figure 9-2: TDS 520 Block Diagram 0

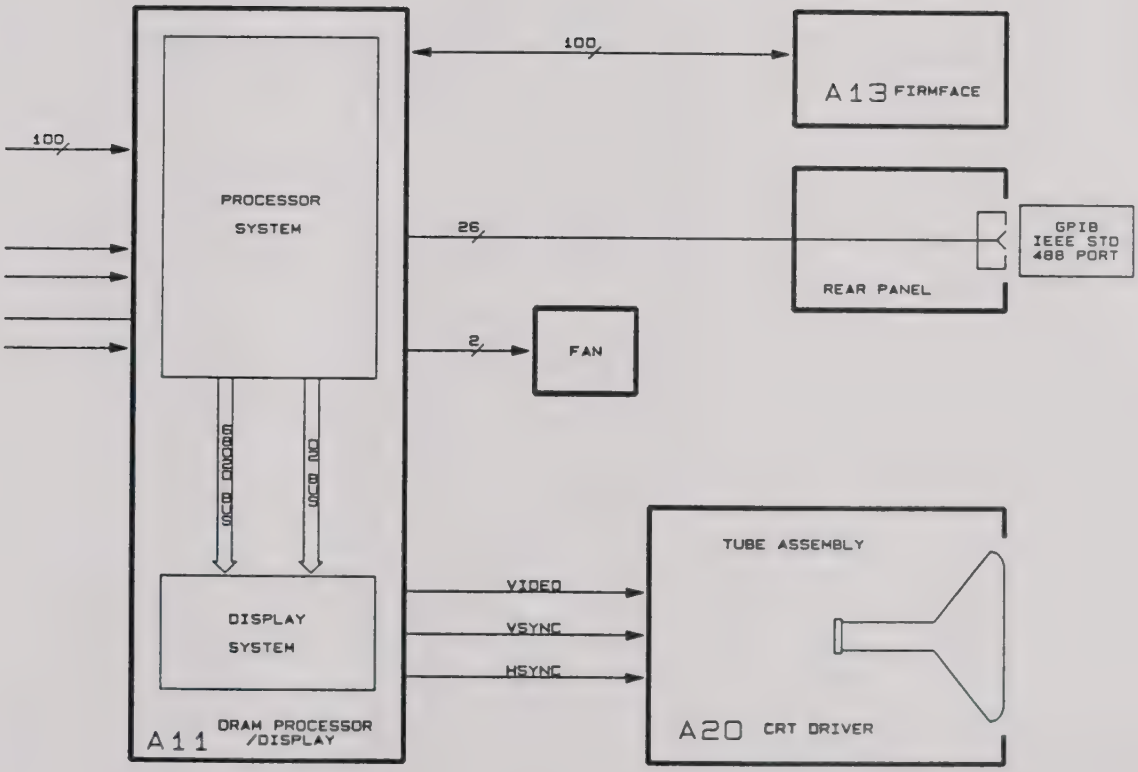


Figure 9-2: TDS 520 Block Diagram ◇0◇ (Cont.)

Replaceable Parts List

This section contains a list of the components that are replaceable for the TDS 520. As described below, use this list to identify and order replacement parts.

Parts Ordering Information

Replacement parts are available from or through your local Tektronix, Inc. service center or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available and to give you the benefit of the latest circuit improvements. Therefore, when ordering parts, it is important to include the following information in your order:

- Part number
- Instrument type or model number
- Instrument serial number
- Instrument modification number, if applicable

If a part you order has been replaced with a different or improved part, your local Tektronix service center or representative will contact you concerning any change in the part number.

Change information, if any, is located at the rear of this manual.

Module Replacement

The TDS 520 is serviced by module replacement so there are three options you should consider:

- **Module Exchange.** In some cases you may exchange your module for a remanufactured module. These modules cost significantly less than new modules and meet the same factory specifications. For more information about the module exchange program, call 1-800-TEKWIDE, ext. BVJ5799.
- **Module Repair.** You may ship your module to us for repair, after which we will return it to you.
- **New Modules.** You may purchase new replacement modules in the same way as other replacement parts.

Using the Replaceable Parts List

The tabular information in the Replaceable Parts List is arranged for quick retrieval. Understanding the structure and features of the list will help you find the all the information you need for ordering replacement parts.

Item Names

In the Replaceable Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, U.S. Federal Cataloging Handbook H6-1 can be used where possible.

Indentation System

This parts list is indented to show the relationship between items. The following example is of the indentation system used in the Description column:

1 2 3 4 5 Name & Description
Assembly and/or Component
Attaching parts for Assembly and/or Component
(END ATTACHING PARTS)
Detail Part of Assembly and/or Component
Attaching parts for Detail Part
(END ATTACHING PARTS)
Parts of Detail Part
Attaching parts for Parts of Detail Part
(END ATTACHING PARTS)

Attaching parts always appear at the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation. Attaching parts must be purchased separately, unless otherwise specified.

Abbreviations

Abbreviations conform to American National Standards Institute (ANSI) standard Y1.1

CROSS INDEX – MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
TK0IK	MODERN METALS	UNIT A/K, 5/F GOLD KING IND. BLDG NO. 35-41 TAI LIN ROAD	KWAI-CHUNG N.T. HONG KONG
TK0488	CURRAN COIL SPRING INC	635 NW 16TH	PORTLAND OR 97209-2206
TK1163	POLYCAST INC	9898 SW TIGARD ST	TIGARD OR 97223
TK1169	DIEMAKERS INC	801 2ND ST PO BOX 278	MONROE CITY MO 63456-1441
TK2162	DERBY MFG	24350 STATE ROAD 23 SOUTH	SOUTH BEND IN 46614-9696
TK2230	COMAIR ROTRON INC SAWYER INDUSTRIAL PKY	12 NORTH ST	SAUGERTIES NY 12477-1096
TK2402	PANEL VIEW	8900 SW BURNHAM E-17	PORTLAND OR 97223
TK2430	ZYTEC CORPORATION	1425 EAST BRIDGE ST	REDWOOD FALLS MN 56283
TK2432	UNION ELECTRIC	15/F #1, FU-SHING N. ROAD	TAIPEI, TAIWAN ROC
0JR05	TRIQUEST CORP	3000 LEWIS AND CLARK HWY	VANCOUVER WA 98661-2999
0J9P9	GEROME MFG CO INC	PO BOX 737	NEWBURG OR 97132
00779	AMP INC	2800 FULLING MILL PO BOX 3608	HARRISBURG PA 17105
50783	PENN-TRAN CORP	ROUTE 144 NORTH PO BOX 1321	WINGATE PA 16880
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON OR 97077-0001

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
1 -1	437-0399-00			1	CABINET,SCOPE:	0J9P9	ORDER BY DESC
-2	200-3695-01			1	COVER,REAR:	80009	200369501
-3	161-0230-01			1	CABLE ASSY,PWR,:3,18 AWG,92.0 L (STANDARD ACCESSORY)	TK2432	ORDER BY DESC
-4	200-2264-00			1	CAP,FUSEHOLDER:3AG FUSES (AMERICAN)	53629	FEK 031 1666
	200-2265-00			1	CAP,FUSEHOLDER:5 X 20MM FUSES (EUROPEAN)	TK0861	FEK 031.1663
-5	159-0013-00			1	FUSE,CARTRIDGE:#AG,6A,250V,FAST BLOW (AMERICAN)	71400	MTH-CW-6
	159-0210-00			1	FUSE,CARTRIDGE:5 X 20MM,5AMP,250V,SLOW (EUROPEAN)	TK0946	ET 5 AMP
-6	367-0247-01			1	HANDLE,CARRYING:11.54 L,W/CLIP	80009	367024701
-7	200-2191-00			2	CAP,RETAINER:PLASTIC	0JR05	ORDER BY DESC
-8	348-1110-00			4	FOOT,CABINET:	TK1163	ORDER BY DESC
-9	348-1254-00			4	PAD,FOOT:TEK BLUE,SANTOPREME	80009	348125400
-10	348-0875-00			1	FLIPSTAND,CAB.:	TK0488	ORDER BY DESC
-11	200-3696-00			1	COVER,FRONT:PLASTIC (STANDARD ACCESSORY)	TK1163	ORDER BY DESC
-12	380-0927-00			1	PANEL,ATTENUATOR:FRONT	TK1163	ORDER BY DESC
-13	366-2112-00			2	KNOB:LARGE,FLUTED	TK1163	ORDER BY DESC
-14	366-2111-00			3	KNOB:SMALL,FLUTED	TK1163	ORDER BY DESC
-15	366-2114-00			1	KNOB:LARGE,DETENTED	TK1163	ORDER BY DESC
-16	101-0127-00			1	TRIM,DECORATIVE:FRONT	TK1163	ORDER BY DESC
-17	650-2298-00			1	REPLACEABLE ASSY:FRAME DSPLY W/FLEX	80009	650229800
-18	378-0366-00			1	FILTER,LT,CRT:6.75X5.50,DARK GRAY	TK2402	ORDER BY DESC
-19	386-6211-00			1	RETAINER,FILTER:5 X 6,PLASTIC	TK1163	ORDER BY DESC
-20	671-1701-00			1	CIRCUIT BD ASSY:FIRMWARE	80009	671170100
-21	214-4287-00			1	ACTUATOR:ELASTOMER MAT,FR PANEL,RBR	TK0IK	ORDER BY DESC
-22	614-0890-00			1	FRONT PNL ASSY:TDS520	80009	614089000

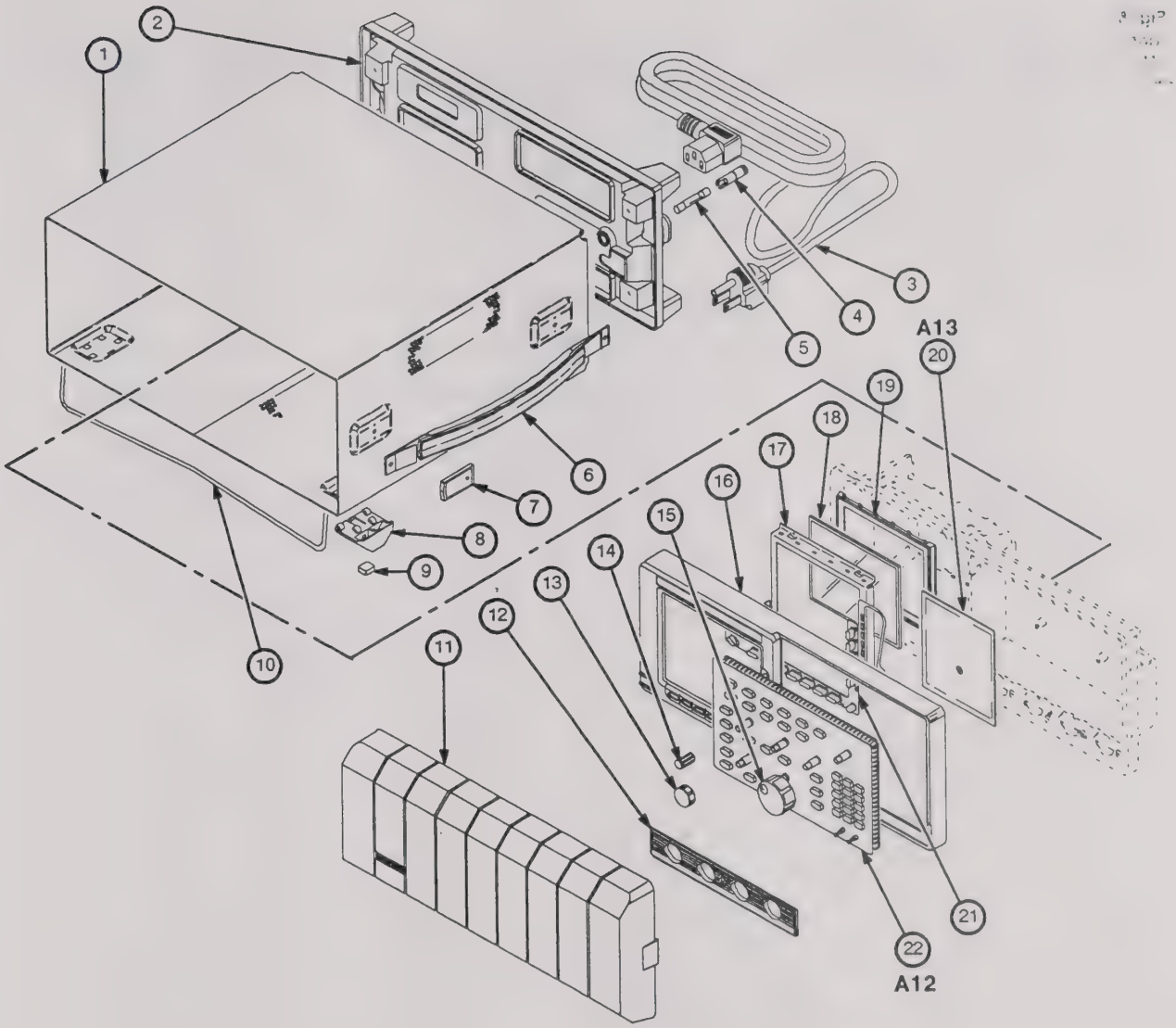

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
A13
21
22
A12

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
2 -1	119-3413-00			1	FAN,TUBEAXIAL:48 VDC,22W,3350RPM,235 CFM	TK2230	032150
-2	671-2002-01			1	CIRCUIT BD ASSY:PROCESSOR DISPLAY (STANDARD)	80009	671200201
	671-1477-00			1	CIRCUIT BD ASSY:PROCESSOR DISPLAY (OPTION 1M)	80009	671147700
-3	441-1902-00			1	CHASSIS,SCOPE:REAR	0J9P9	ORDER BY DESC
-4	671-1568-00			1	CIRCUIT BD ASSY:D1 BUS	80009	671156800
-5	174-1519-00			2	CABLE ASSY,SP,ELEC:2 X 20,0.1 x 0.1,28 AWG,ANALOG POWER	80009	174151900
-6	672-1475-02			1	CIRCUIT BD ASSY:ACQUISITION W/VCO (STANDARD)	80009	672147502
	672-2046-02			1	CIRCUIT BD ASSY:ACQUISITION W/VCO (OPTION 1M)	80009	672204602
-7	119-4092-00			1	ATTENUATOR:FOUR CHANNEL,1 MEGOHM	80009	119409200
-8	407-3878-00			2	BRACKET,CKT BD:PLASTIC	TK1163	ORDER BY DESC
-9	407-3877-00			2	BRACKET,CKT BD:PLASTIC	TK1163	ORDER BY DESC
-10	441-1901-00			1	CHASSIS,SCOPE:TOP	0J9P9	ORDER BY DESC

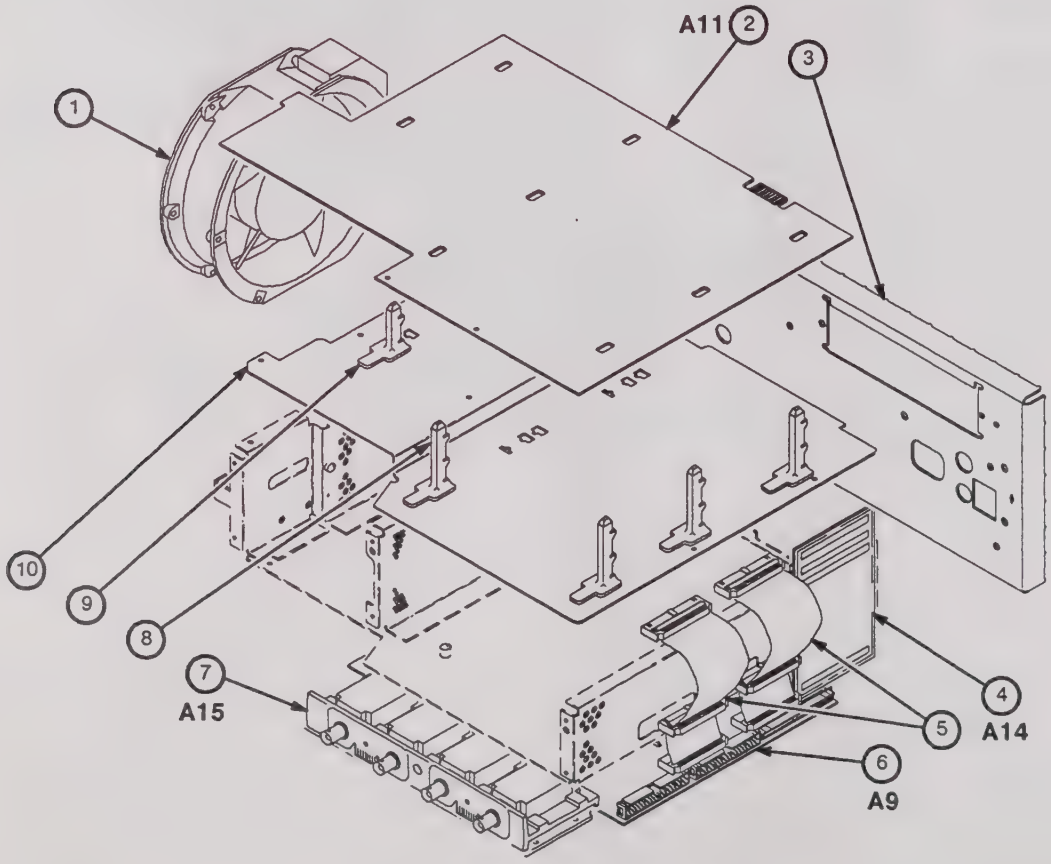


Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
3 -1	640-0071-00			1	DISPLAY,MONOCHR:7 INCH	80009	640007100
-2	119-3371-00			1	PWR SPLY:SWITCHING,400W,MULT OUTPUTS	TK2430	ORDER BY DESC
-3	441-1900-00			1	CHASSIS,SCOPE:MAIN	0J9P9	ORDER BY DESC
-4	386-5871-00			1	SUBPANEL,FRONT:ALUMINUM	TK1169	ORDER BY DESC

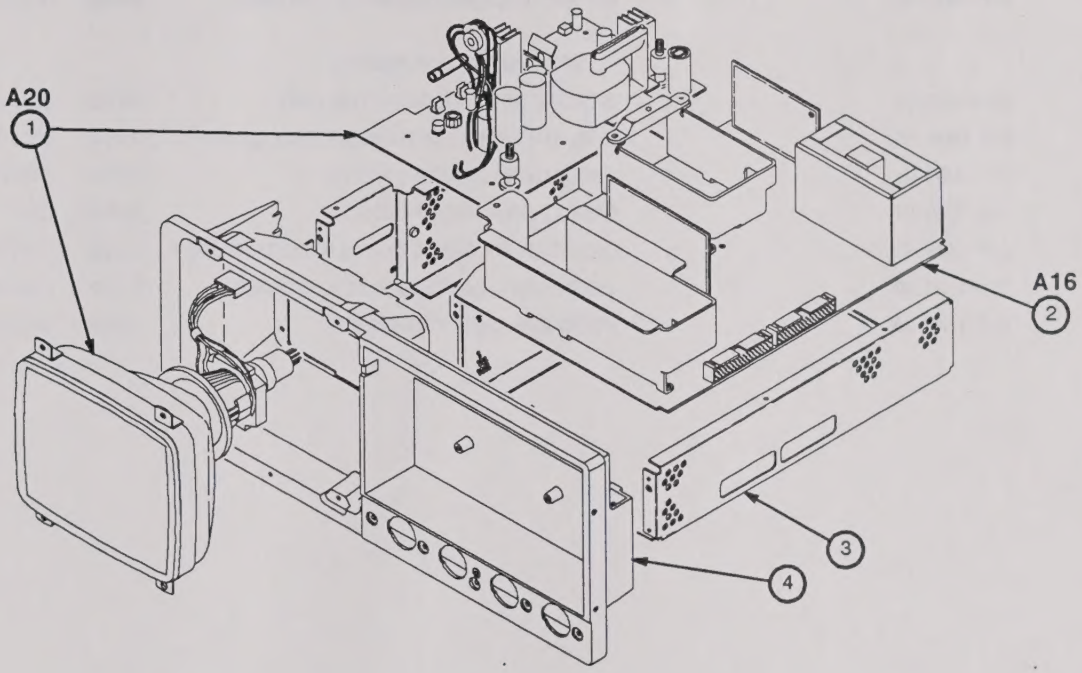


Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
					STANDARD ACCESSORIES		
	----------			1	ACCESSORY PKG:TWO P6139 1.3M PROBES		
	070-8312-00			1	MANUAL,TECH:SERVICE,TDS520	80009	070831200
	070-8316-00			1	MANUAL,TECH:QUICK REF,TDS520/540	80009	070831600
	070-8317-00			1	MANUAL,TECH:TUTORIAL/USER,TDS520/540	80009	070831700
	070-8318-00			1	MANUAL,TECH:PROGRAMMER,TDS FAMILY	80009	070831800
					OPTIONAL ACCESSORIES		
	003-1457-01			1	BIT,TORX DRIVER:MODIFY THE T-20	80009	003145701
	012-0991-00			1	CABLE,COMP:IDC,GPIB:2M,24 COND,12 TW PR	00779	553577-3
	012-0991-01			1	CABLE,GPIB:LOW EMI,1 METER	00779	553577-2
	016-0909-01			1	CASE,CARRYING:SOFTSIDED	TK2162	0587
	016-1135-00			1	CASE,CARRYING:26 X 22 X 15,HARD TRANSFER	80009	016113500
	016-1136-00			1	MOUNTING KIT:RACK MOUNT KIT,TDS500	80009	016113600
	016-1145-00			1	HOOD ASSEMBLY:TDS SERIES	80009	016114500

Replaceable Par

Fig. &
Index
No.

MP MASTER
MA31357